

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., Act. No. 30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

Course Structure for B. Pharmacy. - R15 Regulations
B. Pharmacy

II-II Semester

S.No	Course code	Subject	Th	Tu/Drg/Lab	Credits
1.	15R00401	Pharmaceutical Analysis – I	3	1 - -	3
2.	15R00402	Pharmacognosy – II	3	1 - -	3
3.	15R00403	Pharmaceutical Technology – I	3	1 - -	3
4.	15R00404	Physical Pharmacy –II	3	1 - -	3
5.	15R00405	Pathophysiology	2	1 - -	2
6.	15R00406	Pharmaceutical Analysis – I Laboratory	-	- - 4	2
7.	15R00407	Pharmacognosy – II Laboratory	-	- - 4	2
8.	15R00408	Pharmaceutical Technology – I Laboratory	-	- - 4	2
9.	15R00409	Physical Pharmacy –II Laboratory	-	- - 4	2
10.	15R00410	Comprehensive Online Exams-I	-	- - -	1
			14	5 16	23

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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<i>Subject</i>	PHARMACEUTICAL ANALYSIS – I	<i>Course Code</i>	15R00401
<i>Course year</i>	B. Pharmacy II year	<i>Semester</i>	II
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	1 hr/week
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	3		

COURSEOBJECTIVE

To acquire adequate scientific knowledge regarding basic principles of pharmaceutical analysis.

UNIT I

a) Definition of Analytical chemistry and role of pharmaceutical analysis in pharmaceutical industry.

Significant figures, concept of error, precision, accuracy, rejection of doubtful values with special

reference to volumetric analysis. Calibration of glassware used in volumetric analysis- Burette, pipette and volumetric flask. Methods of expression of concentration(w/w,w/v,v/v).

b) **Theory of Neutralization Titrations:** Acid-base concept, Acidimetry, Alkalimetry, Common ion

effect and solubility product, indicators, Ostwald and quinonoid theories of Indicators

c) **Non-aqueous titration:** Theory, types, solvents used and application in pharmaceutical analysis.

Application of the above methods in the analysis of drugs and formulations as under IP 2007and 2010.

UNIT II

a) General principles, theory and examples of **oxidation-reduction methods**, permanganometry,

ceriometry, iodometry, iodimetry indicators used in these titrations, self indicators.

b) General principles, theory and examples of **Precipitation methods:** Mohr's method, volhard's

method, account of the indicators used in these titrations, Adsorption indicators.

c) **Complexometric titration:** Theory, types and application in pharmaceutical analysis. Indicators

used, Masking and demasking and their applications.

Application of the above methods in the analysis of drugs, as under IP 2007and 2010.

UNIT III

a) Potentiometry: Introduction to EMF, electrochemical cells and half cells, Electrodes, measurement

of potential, pH curve, EMF curve, derivative curve in application to end point determination.

b) Conductometric titrations: Basic concepts, conductivity cell, different types of conductometric titrations.

c) Polarography: Basic concepts, apparatus and principles, different currents, polarographic maxima,

general polarographic analysis, applications in identification and quantification of metals.

d) Amperometric titrations with one polarized electrode, general procedure, titration curves, applications in pharmaceutical analysis.

UNIT IV

Fluorimetry: Theory, Fluorescence and chemical structure, Stokes and anti-Stokes, quantum efficiency, factors affecting the intensity of fluorescence, Instrumentation (double beam), Applications in Pharmaceutical analysis.

Flame Emission photometry Vs Atomic absorption spectroscopy: Emission spectra, Absorption spectra, line spectra, principle of absorption / emission of UV light by elements, instrumentation, applications in pharmaceutical analysis. Focus on interference.

Nephelo-turbidimetry: Introduction, principle, instrumentation of Nephelo-turbidimeter, pharmaceutical application as specified in IP, determination of chlorides and sulphates.

UNIT V

a) Principle and applications of the following instruments and various grades of reagents in a QC laboratory.

i) Refractometry ii) Polarimetry. iii) LR Grade iv) AR grade v) HPLC grade.

b). Role of moisture content determination in QC of pharmaceuticals (including Karl-Fisher method, LOD, IR balance).

TEXT BOOKS:

1. A.H. Beckett & J.B Stanlake Vol. I & II., *Practical Pharmaceutical Chemistry*, Athlone Press of the Univ of London
2. B.K. Sharma, *Instrumental Chemical Analysis*, Goel Publishers.
3. Chatwal & Anand, *Instrumental Methods of Analysis*. Himalaya Publishing Home, 2009.

REFERENCE BOOKS:

1. A.I Vogel, *Quantitative Chemical Analysis*, VI edition, Pearson education Delhi.
2. *Pharmacopoeia (IP, BP, USP)*.
3. D. A. Skoog, *Principles of Instrumental Analysis*, V edition, Thomson Brooks Bangalore.
4. Connors, *a Textbook of Pharmaceutical Analysis*. Wiley India Pvt. Ltd

OUTCOME:

Graduates will conduct, analyze and interpret data of experiments in production, Analytical and clinical aspects

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Subject	PHARMACOGNOSY-II	Course Code	15R00402
Course year	B. Pharmacy II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

Objectives: To make the student aware of Secondary metabolites production in plants and its medicinal significance, cosmeceuticals and nutraceuticals importance.

UNIT I

Glycosides

Definition, classification, properties and general tests of glycosides and detailed Pharmacognostic study of the following glycosides containing drugs:

- a. **Saponin glycosides**- Glycyrrhiza, Ginseng, Dioscorea, Senega, Sarsaparilla
- b. **Cardioactive glycosides**-Digitalis, Squill, Strophanthus, Thevetia
- c. **Anthraquinone glycosides**-Aloe, Senna, Rhubarb, Cascara
- d. **Bitter Glycosides**- Psoralea, Gentian, Chirata

UNIT II

- A) General introduction to cosmeceuticals, role of herbs in cosmetics.
- Study of the following cosmeceuticals - Amla, Henna, Cyperus, Soap Nut, Aloe Vera, Turmeric, Sandal Wood and Bitter Orange Peel.
- B) Definition and study of Nutraceuticals: Garlic, Spirulina, Soya and Royal jelly.

UNIT III

Alkaloids:

Definition, classification, properties and general tests and detailed pharmacognostic study of the following alkaloid containing drugs:

- a. **Pyridine-Piperidine alkaloids**- Tobacco, Lobelia
- b. **Tropane**- Belladonna, Hyoscyamus, Datura, Coca.
- c. **Indole**-Ergot, Rauwolfia, Vinca, Nux Vomica
- d. **Imidazole**-Pilocarpus
- e. **Steroid**- Kurchi, Veratrum, Aswagandha

UNIT IV

- a. **Quinoline-Isoquinoline**-Cinchona, Ipecac, Opium
- b. **Alkaloidal amine**- Ephedra, Colchicum
- c. **Glycoalkaloid**-Solanum
- d. **Purine**-Coffee, Tea, cola
- e. **Quinazoline** -Vasaka

UNIT V

- A) **Biogenesis:** General techniques of biosynthetic studies and basic metabolic pathways.
- Biogenesis of secondary metabolites of pharmaceutical importance.
- B) **Extraction of herbal materials:** Definition of extraction, principle involved in extraction, different types of extraction.
- Factors affecting the process of extraction.
- C) **Phytochemical Screening:** Preparation of extracts, identification and screening of alkaloids, saponins, cardiac glycosides, flavonoids, tannins and anthraquinones in plant extracts.

Text Books:

1. *Kokate CK, Purohit A.P. & Gokhale; Pharmacognosy Nirali Prakashan, New Delhi.*
2. *Text book of Pharmacognosy by Handa and Kapoor.*
3. *Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.*
4. *Pharmacognosy by Brady & Tyler.*
5. *Tutorial Pharmacy by Cooper and Gunn.*
6. *text book of pharmacognosy and phytochemistry by Vinod D Rangari, Vol I and II.*

Reference Books:

1. *Text book of Pharmacognosy by Wallis.*
2. *Herbal drug technology by Pulok Mukharjee*
3. *Pharmacognosy by Trease and Evans*
4. *Biosynthesis of natural products by Manitto P*
5. *Harbone JB, Phytochemical methods, Chapman and Hall*

OUTCOME

- a. know the scientific name, geographical distribution, chemical nature and uses of crude drugs.
- b. know the role of glycosides, alkaloids in treating of various ailments of human beings.
- c. know the significance of nutraceuticals and cosmeceuticals in maintaining the health conditions and appearance.
- d. know various techniques used in biogenesis of secondary metabolites.

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ANANTHAPURAMU**

Subject	PHARMACEUTICAL TECHNOLOGY – I	Course Code	15R00403
Course year	B. Pharmacy II year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal	30 marks
Credits	3		

- Scope and objectives:**
1. This course is designed to understand the aspects of preformulation and formulation of liquid and semi solids
 2. To gain the knowledge on stability associated ICH guidelines.
 3. To gain basic knowledge on blood products.

UNIT I

Preformulation: Goals, Physicochemical properties like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, partition coefficient, organoleptic additives, hydrolysis, oxidation-reduction, racemization, polymerization, etc and their effect on formulation, drug-excipient incompatibility studies., Introduction to Stability testing of finished products as per ICH guidelines.

UNIT II

Liquid dosage forms: Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavours and others, manufacturing packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia.

Dry syrups: Requirements, formulation, methods of preparation, containers, evaluation.

UNIT III

Semisolid dosage forms: Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semi solids, clear gels manufacturing procedure, evaluation and packaging.

Suppositories: Ideal requirements of bases, Different types of bases, displacement value, manufacturing procedure, packing and evaluation.

UNIT IV

Pharmaceutical aerosols: Definition, propellants general formulation, manufacturing and packaging methods, pharmaceutical applications. Quality control tests for aerosols.

UNIT V

Blood Products and Plasma Substitutes: Collection, processing and storage of whole human blood, Concentrated human RBC's, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin, foam plasma substitutes, ideal requirements, PVP, Dextran etc. For control of blood pressure as per IP.

Text Books:

1. L. Lachman, H.A. Lieberman and J.L. Kanig, *Theory & Practice of industrial pharmacy*, Lea & Febieger, Philadelphia Latest Edn.
2. L. V. Allen Jr., N. G. Popovich, H. C. Ansel. *Ansel's pharmaceutical dosage forms and drug delivery systems*. Lippincott Williams & Wilkins, 2005.
3. M. E. Aulton *Pharmaceutics. The science of dosage form design*. - 2nd ed. Churchill-Livingstone, 2002
4. B.M.Mithal. *a text book of pharmaceutical formulations*, 6thed., vallabh prakashan, 2010.

Reference Books:

1. Banker and Rhodes, *Modern pharmaceutics*, marcel dekker series.
2. James Swarbrick, *Encyclopedia of pharmaceutical technology*, 3rd edi, informa healthcare.

Upon the completion of the course the student should be able to:

- a. Acquire sufficient knowledge of preformulation and formulation of liquid and semi solids.
- b. Understand the importance of blood products.
- c. Describe what the pharmaceutical suspension and emulsion is and what roles they play in pharmaceutical science.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Subject	PHYSICAL PHARMACY – II	Course Code	15R00404
Course year	B. Pharmacy II year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal	30 marks
Credits	3		

Scope and objectives: This course is designed to understand the physico-chemical fundamental aspects of solubility, distribution, flow of liquids & solids, complexation & interfacial phenomenon, and to gain knowledge on formulation & stability aspects of dispersion systems, drug decomposition & their kinetics.

UNIT I

Solubility and distribution phenomena: Solvent-solute interaction, solubility of gases in liquids, solubility of liquids in liquids, solubility of solids in liquids, distribution of solutes in immiscible solvents.

Introduction to phenomena of diffusion: Fick's first law and second law.

Complexation: Classification of complexes, methods of preparation, analysis and applications.

UNIT II

Interfacial Phenomena: Liquid interfaces, spreading coefficient, measurement of surface and interfacial tensions, adsorption at liquid interfaces. Adsorption isotherms only (Freundlich's isotherms and Langmuir's isotherms). Surface-active agents and HLB classification, solubilization, detergency. Parachor, Adsorption at solid interfaces. Solid gas and solid liquid interfaces, complex films, electrical properties of interfaces.

UNIT III

Micromeritics and Powder Rheology: Particle size and size distribution, number and weight distribution, particle number, methods for determining particle volume, methods of determining particle size: optical microscopy and sedimentation, measurement of particle shape, specific surface area: methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT IV

Rheology: Newton's law of flow, kinematic viscosity, effect of temperature, Newtonian systems, non-Newtonian systems: pseudoplastic, dilatant, plastic, thixotropy, negative thixotropy. Determination of viscosity, capillary, falling ball and rotational viscometers.

UNIT V

Colloids: Introduction, types of colloidal systems, protective colloids, applications of colloids in pharmacy.

Coarse Dispersions:

Suspensions: Types and theories of suspensions, effect of Brownian motion, interfacial properties of suspended particles, settling in suspensions. Sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations.

Emulsions: Theories of emulsification, physical stability of emulsions.

TEXT BOOKS:

1. Patrick J. Sinko, *Martin's Physical Pharmacy and Pharmaceutical Sciences 5th Edition*. Lippincott Williams.
2. CVSSubhramanyam, *Physical Pharmaceutics*, Vallabhprakashan.
3. Manavalan & Ramaswamy. *Physical pharmaceutics. 2nd ed.* Vignesh publisher, 2008.

REFERENCE BOOKS:

1. Lippincott Williams and Wilkins, *Remington Pharmaceutical Sciences*
2. L. Lachman, H. Lieberman *The Theory And Practice Of Industrial Pharmacy* J. L Kaniz Lee & Febiger Philadelphia, USA.

OUTCOME**Upon the completion of the course the student should be able to:**

- a. Acquire sufficient knowledge of surface and interfacial tension and its measurement.
- b. Appreciate the role of surface active agents in controlling the solubility and stability of the liquids
- c. Understand the different types of flow, thixotropic properties in order to identify and choice the suitable characters for each formulation
- d. Describe what the pharmaceutical suspension and emulsion is and what roles they play in pharmaceutical science.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Subject	PATHOPHYSIOLOGY	Course Code	15R00405
Course year	B. Pharmacy II year	Semester	II
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

Objectives: This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic Pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge of its application in other subject of pharmacy.

UNIT I:

Basic Principles of Cell Injury, Adaptation: Causes of cellular injury, pathogenesis and morphology of cell injury-autolysis, necrosis, apoptosis. Cellular adaptations-atrophy, hypertrophy.

Inflammation: Basic mechanism involved in inflammation and repair, alteration in vascular permeability and blood flow. Acute and chronic inflammation, mediators of inflammation.

UNIT II:

Cancer: Types of cancer, causes of cancer, cell cycle of normal & cancer cell. Apoptosis and cell differentiation. Carcinogenesis and molecular mechanism of carcinogenesis. Markers involved in diagnosis of cancer.

UNIT III:

Pathophysiology of common diseases like hypertension, angina, congestive cardiac failure, atherosclerosis, myocardial infarction, diabetes and thyroid.

UNIT IV:

Pathophysiology of common diseases like epilepsy, psychosis, depression, mania, parkinson's disease, arthritis, gout, osteoporosis and peptic ulcer.

UNIT V:

Pathophysiology of common diseases like asthma, tuberculosis, AIDS, acute & chronic renal failure and urinary tract infections, hepatitis and obesity.

TEXT BOOKS:

1. Harsh mohan, text book of pathology, latest edition.
2. Joseph Dipiro, Pathophysiology and applied therapeutics.

REFERENCE BOOKS:

1. Robbins, SL & Kumar, Basic Pathology. 8th Edition Elsevier.
2. Mary V. Buras, Pathophysiology: A self Instructional programme. Prentice Hall.
3. Mary Lou Mulvihill, Human Diseases: A Systemic approach. Prentice Hall 6th Edition.

Outcomes:

Upon completion of the subject student shall be able to

- a. Describe the etiology and pathogenesis of the selected disease states;
- b. Name the signs and symptoms of the diseases; and
- c. Mention the complications of the diseases.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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<i>Subject</i>	PHARMACEUTICAL ANALYSIS – I LABORATORY	<i>Course Code</i>	15R00406
<i>Course year</i>	B. Pharmacy II year	<i>Semester</i>	II
<i>Theory</i>	4 hrs/week	<i>Tutorial</i>	--
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	2		

I. Experiments:

- 1 Calibration of analytical glass ware.
- 2 Assay of Sodium carbonate by acid-base titration.
- 3 Assay of Ferrous sulfate (redox) ceric ammonium sulfate titration.
- 4 Assay of Sodium benzoate by non-aqueous titration.
- 5 Assay of Sodium chloride by precipitation titration.
- 6 Assay of Calcium gluconate by complexometry.
- 7 Potentiometric titration : Determination of strength of unknown solution HCl, HCl –Acetic acid mixture) against std. NaOH Solution.
- 8 Assay of any drug by potentiometry, (eg. Frusemide, metronidazole).
- 9 Conductometric titration – Determination of strength of unknown solution (HCl, HCl–Acetic Acid mixture) against std. NaOH Solution.
- 10 Determination of refractive index of any sample by Abbe’s refractometer.
- 11 Determination of sucrose concentration by Polarimetry.
- 12 Determination of moisture content by Karl-Fishcer reagent.

II. Demo/work shop

1. Demonstration on gel electrophoresis
2. Demonstration on Polarography

III. Seminar/Assignment/Group discussion

1. List out various drugs that can be assayed by acid-base titration, as per I.P.2007.
2. What is the need of determination of moisture content, what is the limit of moisture in various natural and synthetic drugs?

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<i>Subject</i>	PHARMACOGNOSY-II LABORATORY	<i>Course Code</i>	15R00407
<i>Course year</i>	B. Pharmacy II year	<i>Semester</i>	II
<i>Theory</i>	4 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	2		

EXPERIMENTS:

1. Study of various morphological characters of the drugs mentioned in theory under alkaloids
2. Study of various morphological characters of the drugs mentioned in theory under glycosides.
3. Microscopy (Transverse section & powder) of Datura and Vinca leaf
4. Microscopy (Transverse section & powder) of Cinchona and Ephedra
5. Microscopy (Transverse section & powder) of Nux vomica and Rauwolfia
6. Microscopy (Transverse section & powder) of Digitalis and Senna
7. Microscopy (Transverse section & powder) of Squill and Liquorice
8. Preparation and evaluation of any one herbal cosmeceutical preparation
9. Preliminary phytochemical screening of any one plant
10. Determination of crude fibre content for any one nutraceutical listed under theory.

Seminar/ Assignment/Group discussion

Seminar/assignment related to theory.

Workshop/Demo

Extraction of plant material using Soxhlet apparatus

References

1. Practical Pharmacognosy, C K Kokate, Nirali Prakashan
2. Practical Pharmacognosy, Khandelwal, Nirali Prakashan
3. Practical Pharmacognosy Iyengar, Manipal Press Ltd.
4. Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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<i>Subject</i>	PHARMACEUTICAL TECHNOLOGY – I LABORATORY	<i>Course Code</i>	15R00408
<i>Course year</i>	B. Pharmacy II year	<i>Semester</i>	II
<i>Theory</i>	4 hrs/week	<i>Tutorial</i>	--
<i>End exam</i>	70 marks	<i>Internal</i>	30 marks
<i>Credits</i>	2		

I. EXPERIMENTS:

1. Preparation, evaluation and packaging of
 - a) Solutions: Paracetamol syrup, codeine phosphate linctus
 - b) Ferrous sulphate syrup
 - c) Suspensions: Milk of magnesia
 - d) Emulsions: o/w or w/o type
 - e) Benzyl benzoate lotion
 - f) Ointments: Benzoic acid ointment
 - g) Methyl salicylate ointment
 - h) Suppositories: Boric acid
 - i) Eye drops: Gentamycin.
 - j) Eye ointments: Chloramphenicol.
 - k) Sodiumchloride eye lotion
 - l) Cream: Cetrimide
 - m) Cold cream
 - n) Zincoxide jelly
 - o). Preparation of gel

II. DEMO/ WORKSHOP

Drug-excipient incompatibility studies, ointment filling machine.

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

- 1) Excipients and their concentrations in various dosage forms.
- 2) Seminar on blood products

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Subject	PHYSICAL PHARMACY – II LABORATORY	Course Code	15R00409
Course year	B. Pharmacy II year	Semester	II
Theory	4 hrs/week	Tutorial	NIL
End exam	70 marks	Internal	30 marks
Credits	2		

I. EXPERIMENTS:

1. Determination of bulk density, true density and percentage porosity.
2. Effect of particle size and effect of glidant on angle of repose.
3. Study of particle/globule size distribution by optical microscopy
4. Determination of CMC of a surfactant.
5. Determination of partition coefficient
Iodine between water and carbon tetrachloride
6. Determination of sedimentation volume and degree of flocculation.
7. Effect of addition of Salt/pH/co-solvent on the solubility
8. Surface tension using Stalagmometer.
9. HLB value estimation of surfactants.
10. Viscosity – by Ostwald Viscometer.

II. DEMO/ WORKSHOP

Determination of particle size by AndreasonPipette, Plotting of an adsorption isotherm
Brook field viscometer.

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Viscoelasticity, solubilisation techniques

References

1. *Physical Pharmaceutics, By Mohanta, and Guru Prasad B.S. Publications*

List Of Minimum Equipments Required

1. Ostwald"s viscometer
2. Stalgnometer
3. Digital pH meter
4. Microscopes
5. Stage and eyepiece micrometer
6. Digital electronic balance
7. Thermometer
8. Andreasonpipetter
9. Adequate glasswares