

# SAURASHTRA UNIVERSITY



ACCREDITED GRADE "A" BY NAAC

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## COURSE DETAILS OF T.Y. B.SC. INDUSTRIAL CHEMISTRY (CBCS)

(In Force from June - 2018)

**SEMESTER - V**

**PAPER: BS-IC-501, 502 & 503**

**PAPER: BS-IC-P-504**

**&**

**SEMESTER -VI**

**PAPER: BS-IC-601, 602 & 603**

**PAPER: BS-IC-P-604**

**INDUSTRIAL TRAINING: BS-IC-P-605**

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**SAURASHTRA UNIVERSITY**

**UNIVERSITY CAMPUS**

**RAJKOT-5**

**(GUJARAT) (INDIA)**

**COURSE DETAILS OF T.Y. B.SC.**

**INDUSTRIAL CHEMISTRY**

**(CBCS)**

**(In Force from June - 2018)**

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## CREDIT SYSTEM & MARKS BS-IC-501/502/503

### BS-IC-501 (PHARMACEUTICALS)

(Credits: 04, Hours of Instruction: 60)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-501 PHARMACEUTICALS	1	Introduction to Pharmacopoeia & Dosage Forms	70	14	30
	2	Phytochemicals & Evaluation of Drugs		14	
	3	Pharmaceutical Excipients & Surgical Dressings		14	
	4	Pharmaceutical Drugs & Pharmacognosy		14	
	5	Industrial Microbiology		14	
<b>Total</b>			<b>100</b>		

### BS-IC-502 (POLYMER CHEMISTRY & ANALYTICAL TECHNIQUES)

(Credits: 04, Hours of Instruction: 60)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-502 POLYMER CHEMISTRY & ANALYTICAL TECHNIQUES	1	Polymer Introduction & Properties	70	14	30
	2	Polymerization Techniques & Processing		14	
	3	Polymer Synthesis		14	
	4	Physico-Chemical Techniques		14	
	5	Chromatographic & Spectroscopic Techniques		14	
<b>Total</b>			<b>100</b>		

### BS-IC-503 (HEAVY & FINE CHEMICALS)

(Credits: 04, Hours of Instruction: 60)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-503 HEAVY & FINE CHEMICALS	1	Nitrogen, Phosphorus & Carbon Derivatives	70	14	30
	2	Halogen Derivatives & Catalysts		14	
	3	Food Additives, Essential Oils, Surfactants & Emulsifiers		14	
	4	Alkyl Phosphate, Halocarbon, Alkyl Amine & Industrial Solvents		14	
	5	Specialty Chemicals		14	
<b>Total</b>			<b>100</b>		

## CREDIT SYSTEM & MARKS (THEORY PAPERS) BS-IC-601/602/603

### BS-IC-601 (DYES & INTERMEDIATES) (Credits: 04, Hours of Instruction: 60)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-601 DYES & INTERMEDIATES	1	Introduction to Dyes	70	14	30
	2	Dyes, Intermediates & Analytical Techniques		14	
	3	Azo Dyes		14	
	4	Dispersed Dyes & ETP		14	
	5	Reactive & Vat Dyes		14	
<b>Total</b>			<b>100</b>		

### BS-IC-602 (PETROCHEMICALS & INDUSTRIAL MANAGEMENT) (Credits: 04, Hours of Instruction: 60)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-602 PETROCHEMICALS & INDUSTRIAL MANAGEMENT	1	C1 & C2 Petrochemicals	70	14	30
	2	C3 & C4 Petrochemicals		14	
	3	Aromatics & Gaseous Fuels		14	
	4	Fundamentals of Management		14	
	5	Production Management		14	
<b>Total</b>			<b>100</b>		

### BS-IC-603 (FUNDAMENTALS OF CHEMICAL ENGINEERING) (Credits: 04, Hours of Instruction: 60)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-603 FUNDAMENTALS OF CHEMICAL ENGINEERING	1	Fluid Mechanics	70	14	30
	2	Heat Transfer		14	
	3	Refrigeration		14	
	4	Process Control		14	
	5	Industrial Safety & Development of Project		14	
<b>Total</b>			<b>100</b>		

## CREDIT SYSTEM & MARKS (PRACTICAL PAPERS) BS-IC-P-504

### BS-IC-P-504 (INDUSTRIAL CHEMISTRY PRACTICAL SEMESTER-V)

(Credits: 06, Hours of Instruction: 90)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-P-504 INDUSTRIAL CHEMISTRY PRACTICAL SEMESTER-V	1	Dyes Preparations & Dyeing	105	35	45
	2	Polymer Identification		35	
	3	Polymer Preparation		35	
<b>Total</b>			<b>150</b>		

## CREDIT SYSTEM & MARKS BS-IC-P-604

### BS-IC-P-604 (INDUSTRIAL CHEMISTRY PRACTICAL SEMESTER-VI)

(Credits: 06, Hours of Instruction: 90)

Paper	Unit	Name of Unit	Marks		
			External	Internal	
BS-IC-P-604 INDUSTRIAL CHEMISTRY PRACTICAL SEMESTER- VI	1	Pharmaceutical Preparation & Estimation	105	35	45
	2	Petroleum Analysis		35	
	3	Unit Operations		35	
<b>Total</b>			<b>150</b>		

## CREDIT SYSTEM & MARKS (INDUSTRIAL TRAINING) BS-IC-P-605

### BS-IC-P-605 (INDUSTRIAL TRAINING & PROJECT REPORT SEMESTER-VI)

Paper	Unit	Name of Unit	External Marks
BS-IC-P-605 INDUSTRIAL TRAINING & PROJECT REPORT	1	Project Report	60
	2	Project submission	20
	3	Viva Voce	20
<b>Total</b>			<b>100</b>

**SAURASHTRA UNIVERSITY**

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-501 (PHARMACEUTICALS)

(Effective from June - 2018)

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**BS-IC-501 (PHARMACEUTICALS)**

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**UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)**

**INTRODUCTION TO PHARMACOPOEIA & DOSAGE FORMS**

Pharmacopoeia: Historical background and development of pharmaceutical industry in India in brief. Pharmacopoeias: Development of Indian pharmacopoeia and introduction to other important pharmacopoeias.

Dosage form & Formulations: Introduction to various types of formulations and routes of administration. Aseptic conditions, Need for dosage form.

Pharmaceutical Packaging: Introduction, package selection, packaging materials, ancillary materials, packaging, machinery, quality control of packing materials.

**BOOKS FOR REFERENCES (SEM-5-PAPER-501-UNIT-1)**

1. A Pharmacopoeia of India: (the Indian pharmacopoeia), Indian pharmacopoeia committee.
2. Principles of medicinal chemistry, W.O. Foye; Lea and Febigen Publication, Philadelphia
3. Packing of Pharmaceuticals: Products, Sterilization and Safety Paperback, C.F. Ross

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**UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)**

**PHYTOCHEMICALS & EVALUATION OF DRUGS**

Phytochemicals: Introduction to plant classification and crude drugs, cultivation, collection, preparation for the market and storage of medicinal plants.

Evaluation of crude drugs: Moisture content, Extractive value, Volatile oil content, foreign organic matter. Quantitative microscopic exercises, including of starch leaf content (Palisade ratio, stomatal number and index, Vein inlet number and Vein termination number) crude fiber content.

Chromatographic techniques and Isolation of crude drugs: Introduction to chromatographic method for the identification of crude drugs. Various isolation



procedures for active pharmaceutical ingredients with example for alkaloid, sapogenin, & diosgenin.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-501-UNIT-2)**

1. Pharmacognosy of Powdered Crude Drugs ,M.A. Iyengar
2. Pharmacognosy and Pharmaco biotechnology, Ashutosh Kar
3. Analytical Chromatography book : Dr. G.R. Chatwal

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### **UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **PHARMACEUTICAL EXCIPIENTS & SURGICAL DRESSINGS**

Pharmaceutical Excipients: Various type of pharmaceutical excipients like: Glidants, Lubricants, Diluents, Preservatives, Antioxidants, Emulsifying agents, Coating agents, Binders, Coloring agents, Flavoring agents, Gelatin and other additives like Saccharin and Sorbitol.

Surgical dressings & Quality control: Surgical dressings like Gauzes, Bandages, Sutures and Ligatures with respect to the process, manufacture, methods of sterilization and uses. Pharmaceutical quality control techniques like sterilization and pyrogenic testing, aseptic condition, etc.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-501-UNIT-3)**

1. Organic, Medicinal and Pharmaceutical Chemistry, Wilson, Gisvold, Derge, Lippinett – Toppan.
2. Handbook of Pharmaceutical Excipients, Raymond C. Rowe
3. Surgical Dressings and Wound Management , Steve Thomas

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### **UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **PHARMACEUTICAL DRUGS & PHARMACOGNOSY**

Pharmaceutical Drugs: Classification of various types of drugs with examples for the following bulk drugs. Antimicrobials: Chloramphenicol, Isoniazid, Na-PAS, etc. Analgesics and Anti-inflammatory: Paracetamol, Phenacetin, Mefenic acid, etc. Barbiturates: Phenobarbitol, Pentobarbitol, Talbutal, Butalbital, etc. Anti-hypertensive & Cardiovascular Agents: Methyl dopa. Blockers: Propanolol, Atenolol, etc. Pharmacognosy: Chemical constituents of plants including carbohydrates, amino acids, proteins, Vitamins, terpenoids, flavonoids, and tannins.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-501-UNIT-4)**

1. Organic Chemistry of Drugs Synthesis, Daniel Lednice and L.A. Mitscher; Wiley Inter science.

2. Practical Pharmacognosy, T.N. Vassudevan

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**UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)**

**INDUSTRIAL MICROBIOLOGY**

Introduction of micro-organisms and enzyme system: Brief idea of micro-organisms, their structure, growth and usefulness. Enzyme system useful for transformation and Enzyme catalysed transformation.

Products based on Fermentation: Microbial products, General principle of fermentation process and product processing. Manufacturing of antibiotics like Penicillin – G, Penicillin – V, and Tetracycline, ephedrine and Bakery products like Vinegar, Lactic Acid

**BOOKS FOR REFERENCES (SEM-5-PAPER-501-UNIT-5)**

1. Industrial Microbiology Paperback – 2011, Patel A H
2. Enzyme Technology: Pacemaker of Biotechnology , Prasad N.K
3. Microbiology, Pelczar, Jr., Michael

# SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-502 (POLYMER CHEMISTRY & ANALYTICAL TECHNIQUES)

(Effective from June - 2018)

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## BS-IC-502 (POLYMER CHEMISTRY & ANALYTICAL TECHNIQUES)

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### UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

#### POLYMER INTRODUCTION & PROPERTIES

Polymer, Oligomer, Classification of polymer, Functionality concept, Concept of Cross linking. Molecular weight and molecular weight distribution number, Method of determining molecular weight, Mechanical Properties including, Crystallinity, Tensile strength ( $\sigma$ ), Elongation ( $\epsilon$ ) at break, Compressive strength ( $\sigma_c$ ), Abrasive resistance, Coefficient of friction ( $\mu$ ) Thermal Properties including Melting temperature ( $T_m$ ), Glass transition temperature ( $T_g$ ) & Factor affecting GTT, Heat deflection temperature.

#### BOOKS FOR REFERENCES (SEM-5-PAPER-502-UNIT-1)

1. Vasant R. Gowariker, 2013, N. V. Viswanathan, JayadevSreedhar. Polymer Science, New Age International, 1986 – 11030.
2. Fred W Billmeyer, 2014, Textbook of polymer science, Wiley.

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### UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

#### POLYMERIZATION TECHNIQUES & PROCESSING

Polymerization techniques including three stage addition polymerization, Condensation, Condensation polymerization, Mechanisms and reaction schemes of different polymerization techniques. Polymer Compounding, Molding, Compression molding, Transfer molding, Injection molding, Extrusion molding, Blow molding.

#### BOOKS FOR REFERENCES (SEM-5-PAPER-502-UNIT-2)

1. Vasant R. Gowariker, 2013 N. V. Viswanathan, JayadevSreedhar. Polymer Science, New Age International, 1986 – 11030.
2. Fred W Billmeyer, 2014, Textbook of polymer science, Wiley.

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### **UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **POLYMER SYNTHESIS**

Phenol – formaldehyde resins. Amino resins: Urea formaldehyde and melamine formaldehyde resins. Epoxy resins: Grades of epoxy resins curing process and its importance with mechanism. Elastomers: Poly isoprene, Poly butadiene, Neoprene. Homo polymers, co-polymers such as SBR, ABS, SAN. Polyamides: Nylon-6, Nylone-66, and other Nylons.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-502-UNIT-3)**

1. Vasant R. Gowariker, 2013, N. V. Viswanathan, Jayadev Sreedhar. Polymer Science, New Age International, 1986 – 11030.
2. Fred W Billmeyer, 2014, Textbook of polymer science, Wiley.

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### **UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **PHYSICO-CHEMICAL TECHNIQUES**

Introduction, principle, various factors, measurement, application, importance apparatus of following analysis methods: Conductometric titration, pH and its determination, Potentiometric titrations, Refractometry, Colorimetric analysis, Polarimetric analysis.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-502-UNIT-4)**

1. Analytical Chemistry, J. G. Rick; McGraw Hill Publication Co.
2. Instrumental Methods of analysis, Skoog and West.
3. Chemical Instrument analysis, B.K. Sharma

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### **UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **CHROMATOGRAPHIC & SPECTROSCOPIC TECHNIQUES**

Chromatography: Sampling procedures, sampling of bulk materials, techniques of sampling for solids, Liquids and gases. Various Chromatographic techniques like Gas liquid chromatography and High performance (Pressure) liquid chromatography, Comparison between various types of Detectors used in Chromatography.

Spectroscopy: Principle, construction, working and Specific applications of UV visible spectroscopy, IR spectroscopy, NMR spectroscopy

### **BOOKS FOR REFERENCES (SEM-5-PAPER-502-UNIT-5)**

1. Chemical Instrument analysis B.K. Sharma
2. Instrumental methods of chemical analysis. Willard, Werrit, Dean Setel.
3. Introduction to instrumental analysis. Braun R.D., McGraw Hill Publishing Co.

## SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-503 (HEAVY & FINE CHEMICALS)

(Effective from June - 2018)

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### BS-IC-503 (HEAVY & FINE CHEMICALS)

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#### UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

##### NITROGEN, PHOSPHORUS & CARBON DERIVATIVES

Synthetic Nitrogen Products: Ammonia, Ammonium nitrate and Ammonium Sulphate, Nitric acid. Chlor-alkali industrial products: Caustic soda, Chlorine.

Phosphorous Chemicals: Phosphorus, Phosphoric acid, ammonium phosphate, superphosphate, triple super phosphate.

Industrial Carbon: Carbon black, manufacture of Graphite and Carbon. Lime, Gypsum, Silicon, Calcium Carbide, Silicon Carbide.

##### BOOKS FOR REFERENCES (SEM-5-PAPER-503-UNIT-1)

1. Industrial Chemistry, B. K. Sharma
2. Heavy Organic Chemicals, A.J. Saite, paragon press, U.K.
3. Applied organic chemistry, Kilner E. and Samuel

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#### UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

##### HALOGEN DERIVATIVES & CATALYSTS

Halogen Derivatives – Fluorine, Bromine, Iodine, Hydrobromic acid, Sodium chloride, Sodium Sulphate, Sodium Sulphite, Sodium Thiosulphate, Borax, Boric acid.

Industrial Catalysts – Raney nickel, other forms of nickel, palladium, copper chromate, vanadium, platinum based catalyst. Titanium tetrachloride, titanium dioxide.

##### BOOKS FOR REFERENCES (SEM-5-PAPER-503-UNIT-2)

1. Industrial Chemistry, B. K. Sharma
2. Chemical process industries Shreve R.N.; Mc Graw Hill
3. Applied organic chemistry, Kilner E. and Samuel

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### **UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **FOOD ADDITIVES, ESSENTIAL OILS, SURFACTANTS & EMULSIFIERS**

Food additives: Classification, food additive compounds like monosodium glutamate, tartaric acid, citric acid with manufacturing processes.

Essential oils: Composition and production of some essential oils General organic flavour camphor, citrol, citronellol, methanol, vanillin, coumarin, musk embrittle/ ketones.

Surfactants: Classification, Industrial application.

Emulsifiers: Types, HLV concept, Tweens, Spans.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-503-UNIT-3)**

1. Industrial Chemistry, B. K. Sharma
2. Outline of Chemical Technology, G. E. Drydon; East West Press, New Delhi.
3. Essentials of Medicinal Chemistry, Korolkovas and Burkater; Wiley Inter science.

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### **UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **ALKYL PHOSPHATE, HALOCARBON, ALKYL AMINE & INDUSTRIAL SOLVENTS**

Alkyl Phosphate & Halocarbon: Raw materials, manufacturing process, flow chart and uses of Triphenyl phosphine, alkylphosphates (methyl, ethyl, propyl, butyl), chlorination of methane, Methyl chloride, dichloromethane, chloroform, carbon tetrachloride, ethanolamine.

Alkyl Amines: Raw materials, manufacturing process, flow chart and uses of Methylamines, ethyl amines, di-, tri-alkyl amines (Methyl, ethyl) Butylamines, propyl amines, ethyl and methyl acetoacetates, acetaldehyde.

Special Industrial Solvents: DMF, DMSO, THF, diethyl ether, dimethoxy ethane, dioxane, N-alkylated ethanol amine.

#### **BOOKS FOR REFERENCES (SEM-5-PAPER-503-UNIT-4)**

1. Industrial Chemistry, B. K. Sharma
2. Chemical process industries Shreve R.N.; Mc Graw Hill
3. Applied organic chemistry, Kilner E. and Samuel

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## **UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)**

### **SPECIALTY CHEMICALS**

Manufacture of the following with reference to raw materials, flow chart, properties and uses; Fischer – Tropsch synthesis, Examples, Application, uses and manufacturing of zeolites. Chemical derived from acetylene, propargyl alcohol, 4-butanediol, vinyl chloride. Pyridine, phenol, acetone, phthalic anhydride, glycerol, melamine, formaldehyde.

Biochemical Reagents: Ninhydrin, Tetrazolium blue.

Fine Chemicals: With reference to raw material production process, quality control and specifications of common industrial compound involving two step reactions, lithium aluminum hydride, sodium amide, sodium ethoxide, sodium methoxide.

### **BOOKS FOR REFERENCES (SEM-5-PAPER-503-UNIT-5)**

1. Industrial Chemistry, B.K.Sharma
2. Chemical process industries Shreve R.N.; Mc Graw Hill
3. Applied organic chemistry, Kilner E. and Samuel



# SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-601 (DYES & INTERMEDIATES)

(Effective from June - 2018)

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## BS-IC-601 (DYES & INTERMEDIATES)

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### UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

#### INTRODUCTION TO DYES

Introduction to the history of dyes. Important landmarks in the historical development. Ancient and Modern theory based on structure and Chemical constitution. Classification on the basis of natural and synthetic dyes. Structure and the mode of application to the fibers. Fastness properties, optical whiteners and fluorescent brighteners.

#### BOOKS FOR REFERENCES (SEM-6-PAPER-601-UNIT-1)

1. The Chemistry of Synthetic Dyes Vol. I, II, III. K. Venkataraman, Academic Press.
2. The Analytical Chemistry of Synthetic Dyes, K. Venkataraman, John Wiley, New York.
3. The Dyeing of Synthetic Polymers and Acetate Fibres. D.M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay

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### UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

#### DYES, INTERMEDIATES & ANALYTICAL TECHNIQUES

Benzene Intermediates, Chloro and nitro benzene, Nitro anilines, P-nitro aniline, Nitro anisole, Toluene and Xylene intermediates, di-amino benzenes etc, Naphthalene Intermediates. H-acid, J-acid, R-acid, NW-acid, Chicago acid, Schaffer's acid, Naphthol, Naphtholsulphonic acid, Naphthyl amine sulfonic acids.

Anthraquinone Intermediates: 1-Amino and 2-amino Anthraquinone, Bromamine acid, Quinizarin.

Introduction to analytical techniques like TLC and HPLC for dyes and intermediates.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-601-UNIT-2)**

1. The Chemistry of Synthetic Dyes Vol. I, II, III., K. Venkataraman, Academic Press.
2. The Analytical Chemistry of Synthetic Dyes, K. Venkataraman, John Wiley, New York.
3. The Dyeing of Synthetic Polymers and Acetate Fibers. D. M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay.
4. An Introduction to Synthetic Dyes, D.M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay.
5. Synthetic Dyes, Gurdeep Chatwal.

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### **UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **AZO DYES**

Azo dyes – Various methods of Diazotizations, Sub-classes of Azo Dyes, Monoazo Acid Dyes: Acid Orange II, Acid Orange IV. Mono azo Mordant Dyes: Eriochrome Black A, Eriochrome Black T, Eriochrome Black B, Basis Azo Dyes: Aniline Yellow, Butter Yellow, Chrysodine G, Bismark Brown, Congo Red, Benzopurpurin, Rosanthrene O. Study of Direct Black EW, Brilliant Yellow, Sirius Supra Blue 3RL, Metanil Yellow, Naphthol Blue Black 6B, Chrome Blue Black R, Tartrazine.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-601-UNIT-3)**

1. The Chemistry of Synthetic Dyes Vol. I, II, III., K. Venkataraman, Academic Press.
2. The Analytical Chemistry of Synthetic Dyes, K. Venkataraman, John Wiley, New York.
3. The Dyeing of Synthetic Polymers and Acetate Fibres. D.M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay.
4. An Introduction to Synthetic Dyes, D.M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay.

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### **UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **DISPERSED DYES & ETP**

Introduction of Disperse dyes. Its preparation, characteristics, applications, and mechanism. Synthesis of Disperse Red 4. Effluent treatment and Pollution control for dye stuff industry. Optical whiteners – Fluorescent brighteners. Quality control and factory layout for dye stuff industry.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-601-UNIT-4)**

1. The Chemistry of Synthetic Dyes Vol. I, II, III, K. Venkataraman, Academic Press.
2. The Analytical Chemistry of Synthetic Dyes, K. Venkataraman, John Wiley, New York.
3. The Dyeing of Synthetic Polymers and Acetate Fibres. D.M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay.

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### **UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **REACTIVE & VAT DYES**

Anthraquinone Vat Dyes: Introduction of Anthraquinone (Vat) dyes: Indanthrene yellow 4GK, Indanthrone Blue, Dibenzathrone, Caledon Jade Green, Flavanthrone, Pyranthrone, Indanthrene Brown RRD, Indanthrene Rubene R.

Indigoid dyes: Synthesis of Indigo, Indigosol-O, Thio-indigo, etc.

Reactive dyes: Manufacturing of Reactive Red, Indanthrene Rubene-R. Synthesis of Procion Red dye, Procion Blue HB, Procion Red 5B. Study of Algol Yellow, Algol Rose R, etc.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-601-UNIT-5)**

1. An Introduction to Synthetic Dyes, D.M. Rangnekar and P.P. Singh; Himalaya Publication, Bombay.
2. Synthetic Dyes, Gurdeep Chatwal
3. LUBS Chemistry of synthetic dyes and pigments, R.E. Krieger Publishing Company.
4. Chemistry of dyes and intermediates, Cain, Thorpe and Linstend; 1969
5. Dyeing and chemical technology of textile fibres, E.R. Trotman.
6. Dyes and their Intermediates, N.A. Abrahert, Pergaman Press.

# SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-602 (PETROCHEMICALS & INDUSTRIAL MANAGEMENT)

(Effective from June - 2018)

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## BS-IC-602 (PETROCHEMICALS & INDUSTRIAL MANAGEMENT)

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### UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

#### C1 & C2 PETROCHEMICALS

Manufacture of the following compounds: Methane, Ethylene, Acetylene  
Manufacture of the following compounds from Methane: Methanol, Hydrogen Cyanide, Carbon disulphide. Manufacture of the following compounds from Ethylene: Ethyl chloride, Ethanol, Ethylene oxide, Ethylene glycol, Acetic acid, Styrene, Vinyl Acetate

#### BOOKS FOR REFERENCES (SEM-6-PAPER-602-UNIT-1)

1. Petrochemicals, B. K. Bhaskar Rao, CRC Press, 1990.
2. Chemicals from Petroleum, A. L. Waddams, 2nd Edition, ELBS, London, 1970.
3. Handbook of petroleum refining process. R.A. Mayers; MC Graw Hill, Book Com., New York.

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### UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

#### C3 & C4 PETROCHEMICALS

Chemicals from C<sub>3</sub> Compounds: Manufacture of the following compounds From Propylene: Isopropanol, Cumene, Glycerin, Acrylonitrile, Propylene oxide, Acrylic Acid and Bis-Phenol.

Chemicals from C<sub>4</sub> Compounds: Manufacture of the following compounds From C<sub>4</sub> hydrocarbons: Butadiene, Isobutane, Butanol, Methacrylic acid and Maleic anhydride.

#### BOOKS FOR REFERENCES (SEM-6-PAPER-602-UNIT-2)

1. Dryden's Outlines of Chemical Technology, Gopal Rao M and Marshall Sittig, 3<sup>rd</sup> Edition, East-West Press, 1997.
2. Chemical Technology, G.N. Pandey, 3<sup>rd</sup> Edition, Vikas Publishing House Pvt. Ltd., 1977.

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### **UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **AROMATICS & GASEOUS FUELS**

Manufacture of the following compounds: Benzene, Toluene, Xylene, Naphthalene, Linear alkyl benzenes and their sulphonates, Caprolactum and adipic acid.

Steam reforming: from natural gas and from naphtha. Scheme for CO & H<sub>2</sub> production. SNG production: from naphtha and from via partial oxidation.

#### **BOOKS FOR REFERENCES (SEM-6-PAPER-602-UNIT-3)**

1. Dryden's Outlines of Chemical Technology, Gopal Rao M and Marshall Sittig, 3<sup>rd</sup> Edition, East-West Press, 1997.
2. Chemical Technology, G.N. Pandey, 3<sup>rd</sup> Edition, Vikas Publishing House Pvt. Ltd., 1977.

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### **UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **FUNDAMENTALS OF MANAGEMENT**

Concept of scientific management in industry, Levels of management, Function of management, Decision making, SWOC & PEST analysis, Planning, Organizing, Directing and control. Inventory Control. Motivation in industries, Maslow's hierarchy of needs theory. Management of Human Resources selection.

#### **BOOKS FOR REFERENCES (SEM-6-PAPER-602-UNIT-4)**

1. Economics of Chemical industry. Hempel E.E.
2. Industrial Organization and management. Behel L.L.

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### **UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **PRODUCTION MANAGEMENT**

Production planning, Plant location, Plant layout, Process layout, Product: Classification, Product Development Stages, Product Life Cycle, Product Mix, Product line. Factors involved in product cost estimation, Methods employed for the estimation of capital investment, Capital formation, Elements of cost accounting, Interest and investment costs, time value and money.

#### **BOOKS FOR REFERENCES (SEM-6-PAPER-602-UNIT-5)**

1. Economics of Chemical industry. Hempel E.E.
2. Industrial Organization and management. Behel L.L.

## SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-603 (FUNDAMENTALS OF CHEMICAL ENGINEERING)

(Effective from June - 2018)

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### BS-IC-603 (FUNDAMENTALS OF CHEMICAL ENGINEERING)

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#### UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

##### FLUID MECHANICS

Fluid Mechanics: Definition of fluids and its classification, Newton's law of viscosity. Pressure and its measuring device: Simple manometer, Differential manometer, Inclined manometer. Mechanism and types of flow, Reynold's experiment. Mass and energy balance over the fluid flow system : continuity equation and Bernoulli's equation, major and minor energy losses in flowing fluid.

Flow Meters: Flow measurement in closed channels: Venturimeter, Orificemeter, Nozzlemeter, Pitot tube, Rotameter. Flow measurement in open channels: rectangular notch, triangular notch.

##### BOOKS FOR REFERENCES (SEM-6-PAPER-603-UNIT-1)

1. A Textbook of Fluid Mechanics, by RK Bansal, Laxmi Publication (P) Ltd.
2. Fluid Mechanics, by AK Mohanty, Printice-Hall of India Publication.
3. Chemical Engineer Hand Book, J. H. Perry, McGraw Hill Book Comp.

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#### UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

##### HEAT TRANSFER

Fundamentals of Heat Transfer: Modes of heat transfer, Fourier's law, thermal conductivity, thermal insulators. Heat flow through rectangular slab and cylinder, Compound resistance in series or parallel. Natural convection and forced convection. Heat transfer in combined mode of conduction and convection.

Mass Balance, Energy Balance & Design: Mass and energy balance over a heat exchanger and evaporators, crystallizers, distillation column. Designing a distillation column: McCabe Thiele method for calculation of number of plates, equation of q-line, reflux ratio.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-603-UNIT-2)**

1. Unit Operation- II, by K.A. Gavhane, Nirali Prakashan.
2. Heat & Mass Transfer, by R.K. Rajput, S Chand Publication.
3. Unit Operations in chemical Engineering, McCabe & Smith, McGraw Hill Book Comp.

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### **UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **REFRIGERATION**

Definition and importance of refrigeration, COP, Difference between heat engine, refrigerator and heat pump. Air conditioning, characteristics of good refrigerants, classification of refrigerants, Properties of refrigerants, industrially important refrigerants: Ammonia, CO<sub>2</sub>, SO<sub>2</sub>, Freon-12, Brine, Coding of various types of refrigerants, refrigeration cycles.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-603-UNIT-3)**

1. Refrigeration & Air Conditioning, by Manohar Prasad, New Age International (P) Limited Publication.
2. A Practical Guide to Compressor Technology, by Heinz P Bloch, John Wiley & Son Publication.
3. Compressor Handbook, by Paul C. Hanlon, McGraw Hill Publication.

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### **UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)**

#### **PROCESS CONTROL**

Process Control: Control system and its components, Feedback control system, block diagram, Comparison between positive feedback and negative feedback, terminology, Transfer function, Transportation lag, closed and open loop control system. Control valves.

Modes of Control: ON-OFF Control, Proportional Control, Proportional Integral Control, Proportional Integral Derivative Control.

### **BOOKS FOR REFERENCES (SEM-6-PAPER-603-UNIT-4)**

1. Industrial Process Control, by Ghodrati Kalani, GP Publication.
2. Process Control & Dynamics, Coughnour.
3. Principles of Process Control by D Petranabis, Tata McGraw Hill Publication.

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## **UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)**

### **INDUSTRIAL SAFETY & DEVELOPMENT OF PROJECT**

**Industrial Safety:** Industrial hazards and safety consideration in chemical industries. Principles of safety, Dangerous properties of chemicals, major factors to be considered for safety, effect of chemicals on human body, engineering control of chemical plants hazards, fire and explosion, health hazard, laboratory safety, Color codes for a safety.

**Development of Project:** Development of the project, Evaluation of process, choice of process, plant design Factors, selection of equipment for chemical plant, Various types of reactor and reaction vessels.

#### **BOOKS FOR REFERENCES (SEM-6-PAPER-603-UNIT-5)**

1. Industrial Hazard & Plant Safety, by Sanjoy Banerjee, Taylor & Francis Publication.
2. Industrial Safety and Environment, by Amit Gupta, Laxmi Publication.
3. Practical Guide to Industrial Safety, Nicolas P Cheremisinoff, Taylor & Francis e-Library.



## SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-P-504 (INDUSTRIAL CHEMISTRY PRACTICAL SEMESTER V)

(Effective from June - 2018)

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### BS-IC-P-504

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#### DYES PREPARATIONS & DYEING

##### LIST OF PRACTICALS

1. Preparation of Fast Green-O dye.(Dinitroso resorcinol)
2. Preparation of Lake Red.
3. Preparation of Disperse dye.
4. Preparation of Methyl Orange dye.
5. Preparation of Mordant Yellow dye.
6. Preparation of Butter Yellow.
7. Preparation of Red-2R dye.
8. Preparation of Yellow- 4 G.
9. Dyeing of cotton with Direct dye Congo red.
10. Dyeing of cotton with Basic dye Methylene blue.
11. Dyeing of cotton with Basic dye Crystal violet.
12. Dyeing of cotton with Aniline Black.
13. Dyeing of cotton with Fast Red A.

##### LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Glassware assembly
2. Ice Bath

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#### POLYMER IDENTIFICATION

##### LIST OF PRACTICALS

1. To identify the given polymer sample (Poly methyl methacrylate)
2. To identify the given polymer sample (Poly ethylene)
3. To identify the given polymer sample (Poly propylene)
4. To identify the given polymer sample (Poly vinyl acetate)
5. To identify the given polymer sample (Poly vinyl alcohol)
6. To identify the given polymer sample (Poly vinyl chloride)
7. To identify the given polymer sample (Poly styrene)
8. To identify the given polymer sample (Poly acrylonitrile butadiene styrene)

9. To identify the given polymer sample (Poly styrene acrylonitrile)
10. To identify the given polymer sample ( Nylon-6,6)

**LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:**

1. Glassware assembly
2. Watch glass, Test tube, Copper foil, Melting point assembly, Evaporating dish

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**POLYMER PREPARATION**

**LIST OF PRACTICALS**

1. Preparation of Glyptal Resin.
2. Preparation of Urea Formaldehyde.
3. Preparation of Melamine Formaldehyde.
4. Preparation of Novolac Resin.
5. Preparation of Resol Resin.
6. Preparation of Cellulose Acetate.

**LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:**

1. Glassware assembly
2. Distillation assembly

## SAURASHTRA UNIVERSITY

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-P-604 (INDUSTRIAL CHEMISTRY PRACTICAL SEMESTER VI)

(Effective from June - 2018)

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### BS-IC-P-604

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#### PHARMACEUTICAL PREPARATION & ESTIMATION

##### LIST OF PRACTICALS

1. Preparation of Methyl Salicylate.
2. Preparation of Cold Cream.
3. Preparation of Benzilic acid.
4. Preparation of Glucosazone.
5. Preparation of Acetophenone phenyl hydrazone.
6. Preparation of Benzocaine.
7. Preparation of Aspirin.
8. Preparation of 2,3-diphenyl quinoxaline.
9. Determination of % W/W of Lactic acid and Lactide together.
10. Determination of Aspirin content in given sample.
11. Estimation of Isoniazid in given sample.
12. Estimation of Neutralization of Antacid (ENO) powder.
13. Determination of assay of Zinc Oxide (ZnO IP-85).
14. Determination of % of Vitamin-C in given tablet.
15. Determination of % of Vitamin-C in given pure powder.
16. Analysis of % of Mg in a given sample of Talcum powder.

##### LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Glassware assembly
2. Titration assembly
3. Distillation assembly

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#### PETROLEUM ANALYSIS

##### LIST OF PRACTICALS

1. Determination of Penetration number of given bituminous sample.
2. Determination of Softening point of bituminous sample.
3. Determination of the Smoke point of light petroleum products.
4. Determination of the Kinematic Viscosity of an oil sample using Redwood Viscometer.

5. Determination of the Kinematic Viscosity of an oil sample using Saybolt Viscometer.
6. Determination of Flash and Fire point of the given sample by using Cleaveland open cup apparatus.
7. Determination of the % moisture present in a given sample of liquid petroleum by Dean and Stark's method.
8. Determination of Cloud and Pour point of heavy petroleum product.
9. Determination of Aniline point and Diesel Index of petroleum products and hydrocarbon solvents.
10. Determination of % carbon residue of liquid petroleum products.

#### **LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:**

1. Distillation assembly
2. Glassware assembly
3. Say bolt Viscometer
4. Redwood Viscometer
5. Smoke Point apparatus
6. Penetrometer
7. Softening Point apparatus
8. Aniline Point apparatus
9. Dean and Stark's assembly
10. Cloud and Pour apparatus
11. Carbon Residue apparatus
12. Cleaveland open cup apparatus

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### **UNIT OPERATIONS**

#### **LIST OF PRACTICALS**

1. Crushing of given raw materials in Jaw Crusher and to determine average particle size and reduction ratio.
2. Crushing of given raw materials in Roll Crusher and to determine average particle size and reduction ratio.
3. Analysis of given sample using Sieve Shaker and find the average particle size.
4. Study the operation of Ball Mill and calculate reduction ratio and find the average particle size.
5. Determination of efficiency of Cyclone Separator.
6. Determination of equilibrium solubility of following system at room temperature and to plot saturation curve on triangular graph paper for  $\text{CHCl}_3\text{-H}_2\text{O-CH}_3\text{COOH}$  system.
7. Determination of equilibrium solubility of following system at room temperature and to plot saturation curve on triangular graph paper for  $\text{CCl}_4\text{-H}_2\text{O-CH}_3\text{COOH}$  system.

8. To study Psychrometric property of ambient air using Psychrometric chart and to find out: 1) Dew point 2) Enthalpy 3) Absolute humidity 4) Percentage humidity

**LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:**

1. Glassware assembly
2. Size reduction equipment like Jaw Crusher, Roll Crusher, Sieve Shaker, Ball Mill etc.
3. Cyclone Separator
4. Thermometer-Porcelain dish- cotton wick system.

**SAURASHTRA UNIVERSITY**

THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)

Syllabus (CBCS) of BS-IC-P-605 (INDUSTRIAL TRAINING & PROJECT REPORT)

(Effective from June - 2018)

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**BS-IC-P-605**

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**INDUSTRIAL TRAINING & PROJECT REPORT**

Minimum 3 weeks of Industrial training, Project report must be submitted of minimum 50 pages after completion of training.

**SAURASHTRA UNIVERSITY**  
THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)  
SCHEME OF ASSESSMENT  
(Effective from June - 2018)

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**SCHEME OF ASSESSMENT SEMESTER - V:**

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**Theory:**

Paper carries 70 Marks

Six Lectures/ Week

BS-IC-501 (Theory + Internal Theory) (70+30=100)

BS-IC-502 (Theory + Internal Theory) (70+30=100)

BS-IC-503 (Theory + Internal Theory) (70+30=100)

**Practical:**

Practical carries 35 Marks

Two days/Week

BS-IC-P-504 (Practical + Internal Practical) (105+45=150)

- |                              |            |
|------------------------------|------------|
| 1) Dyes Preparation & Dyeing | (35 Marks) |
| 2) Polymer Identification    | (35 Marks) |
| 3) Polymer Preparation       | (35 Marks) |

PAPER NO.	NO. OF PAPER	THEORY EXAM HOURS	PRACTICAL EXAM HOURS
BS-IC-501, 502 & 503 & BS-IC-P-504	One	2:30 Hours	3 Hours

**SAURASHTRA UNIVERSITY**  
THIRD YEAR B.SC. (INDUSTRIAL CHEMISTRY)  
SCHEME OF ASSESSMENT  
(Effective from June - 2018)

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**SCHEME OF ASSESSMENT SEMESTER - VI:**

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**Theory:**

Paper carries 70 Marks

Six Lectures/ Week

BS-IC-601 (Theory + Internal Theory) (70+30=100)

BS-IC-602 (Theory + Internal Theory) (70+30=100)

BS-IC-603 (Theory + Internal Theory) (70+30=100)

**Practical:**

Practical carries 35 Marks

Two days/Week

BS-IC-P-604 (Practical + Internal Practical) (105+45=150)

- |  |            |
|--|------------|
| 1) Pharmaceutical Estimation & Preparation | (35 Marks) |
| 2) Petroleum Analysis                      | (35 Marks) |
| 3) Unit Operations                         | (35 Marks) |

PAPER NO.	NO. OF PAPER	THEORY EXAM HOURS	PRACTICAL EXAM HOURS
BS-IC-601, 602 & 603 & BS-IC-P-604	One	2:30 Hours	3 Hours
BS-IC-P-605	-	-	VIVA-VOCE