

BHAVNAGAR UNIVERSITY

BHAVNAGAR

(NACC Accreditation Grade “B”)

CREDIT AND SEMESTER SYSTEM

SYLLABUS

BACHELOR OF SCIENCE (B.Sc.)

INDUSTRIAL CHEMISTRY

(In Force From Academic Year: 2011-2012)

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B.Sc.
Credit and Semester System Syllabus

NAME OF THE SUBJECT: INDUSTRIAL CHEMISTRY

SEMESTER: 3rd

| SR. NO. | PAPER NO | NAME OF THE PAPER | TOTAL MARKS EXT+INT*= TOTAL | PASSING STANDARD EXT+INT= TOTAL | TOTAL TEACHING HOURS | EXAM. HOURS | CREDITS |
|----------------|-----------------|--|--|--|---------------------------------|------------------------|----------------|
| 1 | IC-301 | Material Science – I | 70 + 30 = 100 | 28 + 12 = 40 | 15 Weeks × 03 Hours = 45 | 03 | 03 |
| 2 | IC-302 | Fundamental of Chemical Engineering – I | 70 + 30 = 100 | 28 + 12 = 40 | 15 Weeks × 03 Hours = 45 | 03 | 03 |
| 3 | IC-303 | Heavy and Fine Chemicals & Catalysts – I | 70 + 30 = 100 | 28 + 12 = 40 | 15 Weeks × 03 Hours = 45 | 03 | 03 |
| 4 | IC-304 | Practicals | 90 + 00 = 90 (External Only) | 36 + 00 + 36 | 15 Weeks x 09 Hours = 135 | 09 | 09 |

| * <u>INTERNAL</u> | <u>MARKS</u> |
|--------------------------|---------------------|
| ASSIGNMENT | 10 |
| SEMINAR | 10 |
| TEST | 10 |



B.Sc.
Credit and Semester System Syllabus

NAME OF THE SUBJECT: INDUSTRIAL CHEMISTRY

SEMESTER: 4th

| SR. NO. | PAPER NO | NAME OF THE PAPER | TOTAL MARKS EXT+INT*= TOTAL | PASSING STANDARD EXT+INT= TOTAL | TOTAL TEACHING HOURS | EXAM. HOURS | CREDITS |
|----------------|-----------------|---|--|--|---------------------------------|------------------------|----------------|
| 1 | IC-401 | Material Science – II | 70 + 30 = 100 | 28 + 12 = 40 | 15 Weeks × 03 Hours = 45 | 03 | 03 |
| 2 | IC-402 | Analytical Chemistry | 70 + 30 = 100 | 28 + 12 = 40 | 15 Weeks × 03 Hours = 45 | 03 | 03 |
| 3 | IC-403 | Heavy and Fine Chemicals & Catalysts – II | 70 + 30 = 100 | 28 + 12 = 40 | 15 Weeks × 03 Hours = 45 | 03 | 03 |
| 4 | IC-404 | Practicals | 90 + 00 = 90 (External Only) | 36 + 00 + 36 | 15 Weeks x 09 Hours = 135 | 09 | 09 |

| * <u>INTERNAL</u> | <u>MARKS</u> |
|--------------------------|---------------------|
| ASSIGNMENT | 10 |
| SEMINAR | 10 |
| TEST | 10 |

**B.Sc. (INDUSTRIAL CHEMISTRY)****SEMESTER – III**

PAPER NO – IC-301: Material Science – I:

Credit: 03**Total Marks: 100****Marks: Semester End Examination: 70****Continues Internal Evaluation: 30**

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|------------|--|----------------|----------------|
| Unit – I | <u>Electro-thermal and Electro-chemical processes:</u> 1. Manufacture of: ♣ Calcium carbide. ♣ Silicon carbide. ♣ Graphite. ♣ Soda ash. ♣ Caustic soda. 2. Fuel industry: ♣ Fossil fuels and their classifications, gaseous, liquid & solid fuels. | 15 | 23 + 10 = 33 |
| Unit – II | <u>Phosphorus, sulphur and nitrogen industries:</u> Production of: ♣ Elemental phosphorus pentoxide ♣ Phosphoric acid by electric furnace method ♣ Elemental sulphur mining by Frasch Process ♣ Sulphuric acid and oleum by contact process ♣ Nitric acid by ammonia oxidation process | 15 | 23 + 10 = 33 |
| Unit – III | <u>Metallurgy Industries:</u> 3. Micro constituents of: ♣ Iron ♣ Carbon steels ♣ Alloy steels 4. Important heat-treatment process alloy of:- ♣ Aluminium ♣ Copper ♣ Lead ♣ Zinc ♣ Nickel | 15 | 24 + 10 = 34 |

Break up of Continuous Internal Evaluation:

| | |
|--------------------|-----------------|
| 1. Assignments | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total Marks | 30 Marks |

Reference / Text- Books/ Additional Reading:

1. Chemical Engineering Material by O.P. Agarwal (Tata Publication).
2. Chemical Process Industries by R. N. Shreeve (McGraw Hill Publication).
3. Outline of Chemical Technology by Charles E. Dryden.
4. Engg. Chemistry by Jain and Jain (Danpatray & Sons).
5. Industrial Chemistry by B. K. Sharma (Goel Publication).
6. Unit process in organic synthesis by P. H. Groggins.



PAPER NO – IC-302: Fundamental of Chemical Engineering – I:

Credit: 03**Total Marks: 100****Marks: Semester End Examination: 70****Continues Internal Evaluation: 30**

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|------------|--|----------------|----------------|
| Unit – I | <u>Dimensions and units, basic chemical calculation of:</u> <ul style="list-style-type: none">♣ Atomic weight♣ Molecular weight♣ Equivalent weight♣ Mole composition of liquid mixture, gaseous mixture and solid mixture. | 15 | 23 + 10 = 33 |
| Unit – II | <u>Material balance without chemical reaction:</u> Flow sheet diagram for material balance simple material balance with or without recycle or by-pass for chemical engineering operations such as: <ul style="list-style-type: none">♣ Distillation♣ Absorption♣ Crystallization♣ Evaporation♣ Extraction♣ Mixing♣ Filtration | 15 | 23 + 10 = 33 |
| Unit – III | <u>Basis of calculation, units for composition of systems:</u> <ul style="list-style-type: none">♣ Scale of specific gravity♣ Behavior of mixtures♣ Average molecular weight and density of gaseous mixtures, volume changes with changes in composition.♣ Combustion and calorific values of fuels | 15 | 24 + 10 = 34 |

Break up of Continuous Internal Evaluation:

| | |
|--------------------|-----------------|
| 1. Assignments | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total Marks | 30 Marks |

Reference / Text- Books/ Additional Reading:

1. Chemical Process Principles- I by Haygen, Watson and Regartz. (Asia Pub. House).
2. Stoichiometry by Bhatt, B. I. and Vora S. M. (Tata McGraw Hill).
3. Introduction of Chemical Engg. Thermodynamics (IVth Edition).
4. Basic Principals and Calculation in Chemical Engg. By David M. Himmelblan (Prentices Hall Inc.)
5. Thermal Engg. By P. L. Bllaney (Khanna Publishers, Delhi).
6. Outline of Chemical technology by Charles E. Dryden.



PAPER NO – IC-303: Heavy and Fine Chemical & Catalyst – I:

Credit: 03**Total Marks: 100****Marks: Semester End Examination: 70****Continues Internal Evaluation: 30**

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|----------|--|----------------|----------------|
| Unit – I | <u>Production of:</u> <ul style="list-style-type: none">♣ Ammonia, ammonium nitrate & ammonium sulphate♣ Phosphorus, phosphoric acid, ammonium phosphate, super phosphate♣ Potassium chloride♣ Industrial carbon black♣ Gypsum | 15 | 23 + 10 = 33 |
| Unit – I | <u>Production of:</u> <ul style="list-style-type: none">♣ Bromine♣ Iodine♣ Flourine♣ Hydrobromic acid♣ Sodium chloride♣ Sodium sulphate, sodium sulphite, & sodium thiosulphate♣ Borax & boric acid | 15 | 23 + 10 = 33 |
| Unit – I | <u>Catalysis:</u> <ul style="list-style-type: none">♣ Catalysis and its characteristics♣ Mechanism of catalytic reactions♣ Properties of solid catalysis-contact masses♣ Preparations of catalyst♣ Promoters and inhibitors | 15 | 24 + 10 = 34 |

Break up of Continuous Internal Evaluation:

| | |
|--------------------|-----------------|
| 1. Assignments | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total Marks | 30 Marks |

Reference / Text- Books/ Additional Reading:

1. Chemical process industries by R. N. Shreeve.
2. Unit process in organic synthesis by P. H. Groggins.
3. Outline of chemical technology by C. E Dryden
4. Synthetic organic compounds by O. P. Agarwal.
5. Industrial chemistry by B. K. Sharma.



PAPER NO – IC-304: Industrial Chemistry Practicals:

Credit: 09

Total Marks: 90 (External Only)

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|------------|---|----------------|----------------|
| Unit – I | <u>Organic preparations (One Step):</u> <ul style="list-style-type: none">♣ Acetanilide from Aniline♣ Acetyl salicylic acid from Salicylic acid♣ p-Nitro acetanilide form Acetanilide♣ p-Bromo acetanilide form Acetanilide♣ Methyl Salicylate from Salicylic acid♣ Benzanilide from Aniline♣ Benzoic acid from Toluene♣ p-Amino Acetanilide from p- Nitro Acetanilide | 50 | |
| | | | |
| Unit – II | Inorganic Qualitative analysis (4 Radicals) (Minimum 10) | 60 | |
| | <u>Analysis:</u> <ul style="list-style-type: none">♣ Water (Suspended solids, Total dissolved solids, Carbonates and Bicarbonates)♣ Cement (Loss of ignition. Total insoluble residue, Total silica and oxide) | 25 | |
| Unit – III | Viva-voce | - | |

Reference / Text- Books/ Additional Reading:

1. Vogel's Textbook of Practical Inorganic Chemistry, 5th Edition by B. S. Furniss et al.
2. Inorganic Qualitative Analysis by Vogel.
3. Practical organic chemistry by Vogel.
4. Inorganic qualitative analysis by Carvon.
5. Organic qualitative analysis by Mann sunder.

**B.Sc. (INDUSTRIAL CHEMISTRY)****SEMESTER – IV**

PAPER NO – IC-401: Material Science – II:

Credit: 03**Total Marks: 100****Marks: Semester End Examination: 70****Continues Internal Evaluation: 30**

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|-----------|---|----------------|----------------|
| Unit – I | <u>Elementary concept of unit operations and unit processes:</u> <ul style="list-style-type: none">♣ Flow sheet preparation and elements of flow diagram♣ Symbols♣ Abbreviations and rules of flow sheet preparations♣ Types of processes and flow sheets diagram | 15 | 23 + 10 = 33 |
| Unit – II | <u>Surface coating industries:</u> <ul style="list-style-type: none">♣ Corrosion and erosion♣ Theory of corrosion♣ Corrosion reaction♣ Special corrosions♣ Factors affecting on corrosion rates♣ Protection against corrosion inhibitors♣ Protective coating and surface preparation♣ Metallic, inorganic & organic coatings♣ Pigment and paint manufacture: white, yellow, green, brown, blue, tonners and lakes, varnish and lacquers | 15 | 23 + 10 = 33 |
| Unit – II | <u>Ceramic industries:</u> <ul style="list-style-type: none">♣ Basic ceramic industries♣ Clay product♣ Specialized ceramic products♣ Refractories <u>Cement:</u> <ul style="list-style-type: none">♣ Manufacture of lime♣ Portland cement <u>Glass Industries:</u> <ul style="list-style-type: none">♣ Manufacture of different types of glasses♣ Special glass | 15 | 24 + 10 = 34 |

Break up of Continuous Internal Evaluation:

| | |
|--------------------|-----------------|
| 1. Assignments | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total Marks | 30 Marks |

Reference / Text- Books/ Additional Reading:

1. Chemical Engineering Material by O.P. Agarwal (Tata Publication).
2. Chemical Process Industries by R. N. Shreeve (McGraw Hill Publication).
3. Outline of Chemical Technology by Charles E. Dryden.
4. Engg. Chemistry by Jain and Jain (Danpatray & Sons).
5. Industrial Chemistry by B. K. Sharma (Goel Publication).



PAPER NO – IC-402: Analytical Chemistry:

Credit: 03

Total Marks: 100
Marks: Semester End Examination: 70
Continues Internal Evaluation: 30

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|------------|--|----------------|----------------|
| Unit – I | <u>Analytical reagents:</u> <ul style="list-style-type: none">♣ Sodium carbonate, sodium bicarbonate, sodium potassium tartrate♣ Potassium dicarbonate♣ Oxalic acid, succinic acid♣ Fehling A & B solution♣ Karl-flasher reagent♣ Lithium aluminum hydride♣ Sodium ethoxide reagents♣ Ninhydrine, tetrazolium blue, methyl violet, ethylene blue | 15 | 23 + 10 = 33 |
| Unit – II | <u>Manufacture of the following:</u> <ul style="list-style-type: none">♣ Fisher Tropsch synthesis, examples♣ Application and uses of Zeolites as catalyst♣ Isomerisation, dehydration / hydroxylation material derived from acetylene, 1-4 butandiol, acrylates♣ Vinyl esters, vinyl chloride♣ Phenol, acetone, phthalic anhydride♣ Glycerol, sorbitol, melamine♣ Formic acid and formaldehyde | 15 | 23 + 10 = 33 |
| Unit – III | <u>Raw material, kinetics and uses of:</u> <ul style="list-style-type: none">♣ Triphenyl phosphine♣ Alkyl phosphate♣ Chlorination of methane♣ Ethanol amine: mono, di, tri, ethanolamine♣ Methyl ethyl aceto acetate♣ Industrial solvents: DMF, THF, dioxane, diethyl ether | 15 | 24 + 10 = 34 |

Break up of Continuous Internal Evaluation:

| | |
|--------------------|-----------------|
| 1. Assignments | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total Marks | 30 Marks |

Reference / Text- Books/ Additional Reading:

1. Chemical Process Principles- I by Haygen, Watson and Regartz. (Asia Pub. House).
2. Stoichiometry by Bhatt, B. I. and Vora S. M. (Tata McGraw Hill).
3. Introduction of Chemical Engg. Thermodynamics (IVth Edition).
4. Basic Principals and Calculation in Chemical Engg. By David M. Himmelblan (Prentices Hall Inc.)
5. Thermal Engg. By P. L. Bllaney (Khanna Publishers, Delhi).
6. Outline of Chemical technology by Charles E. Dryden.



PAPER NO – IC-403: Heavy and Fine Chemical & Catalyst – II:

Credit: 03**Total Marks: 100****Marks: Semester End Examination: 70****Continues Internal Evaluation: 30**

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT |
|------------|---|----------------|----------------|
| Unit – I | <u>Detergent Industries:</u> <ul style="list-style-type: none">♣ Introduction♣ Principal groups of synthetic detergents♣ Classification of surface active agents♣ Anionic detergents♣ Cationic detergents♣ Amphoteric detergents | 15 | 23 + 10 = 33 |
| Unit – II | <u>Soap Industries:</u> <ul style="list-style-type: none">♣ Manufacture of soap♣ Toilet and transparent soap♣ Metal soap♣ Cleansing action of soap♣ Oil to be used for soaps | 15 | 23 + 10 = 33 |
| Unit – III | <u>Industrial catalysts:</u> <ul style="list-style-type: none">♣ Raney nickel, other from of nickel♣ Palladium♣ Copper chromate♣ Vanadium, vanadium pentoxide♣ Titanium tetrachloride, titanium dioxide | 15 | 24 + 10 = 34 |

Break up of Continuous Internal Evaluation:

| | |
|--------------------|-----------------|
| 1. Assignments | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total Marks | 30 Marks |

Reference / Text- Books/ Additional Reading:

1. Chemical process industries by R. N. Shreeve.
2. Unit process in organic synthesis by P. H. Groggins.
3. Outline of chemical technology by C. E Dryden
4. Synthetic organic compounds by O. P. Agarwal.
5. Industrial chemistry by B. K. Sharma



PAPER NO – IC-404: Industrial Chemistry Practicals:

Credit: 09

Total Marks: 90 (External Only)

| UNIT | DETAILED SYLLABUS | TEACHING HOURS | MARKS / WEIGHT | |
|------------|---|----------------|----------------|----|
| Unit – I | Preparation of Fine Chemicals: | 40 | | |
| | ♣ Magnesium hydroxide from sea-water | | | |
| | ♣ Magnesium carbonate from sea-water | | | |
| | ♣ Magnesium trisilicate from sea-water | | | |
| | ♣ Cuprous chloride from copper | | | |
| | ♣ Magnesium stearate from stearic acid | | | |
| Unit – II | ♣ Zinc Stearate from stearic acid | 70 | | |
| | Qualitative organic analysis of binary mixtures:- (Minimum 10) | | | 25 |
| | Physico-chemical experiments:- (Partition coefficient, adsorption, ester hydrolysis, relative strength) | | | |
| Unit – III | Viva-voce | - | | |

Reference / Text- Books/ Additional Reading:

1. Vogel's Textbook of practical inorganic chemistry, 5th Edition by B. S. Furniss et al.
2. Inorganic qualitative Analysis by Vogel.
3. Inorganic preparation by Vogel.
4. Organic qualitative analysis by Mann sunder.