

KAKATIYA UNIVERSITY
U.G. Skill Enhancement Course - IV
(Under CBCS)
B.Sc. Final Year
SEMESTER - VI
(FOR ALL SCIENCE FACULTY DEPARTMENTS)

QUANTITATIVE APTITUDE TEST

Credits: 2

Theory: 2 hours/week

Marks - 40

Unit – I ARITHMETICAL ABILITY

- 1.1 Arithmetical Ability:** Ratio & Proportion
- 1.2 Arithmetical Ability:** Time & Work, Time & Distance
- 1.3 Arithmetical Ability:** Simple Interest, Compound Interest
- 1.4 Arithmetical Ability:** Stocks & Shares

Unit – II DATA INTERPRETATION

- 2.1 Data Interpretation:** Tabulation
- 2.2 Data Interpretation:** Bar Graphs
- 2.3 Data Interpretation:** Pie Charts
- 2.4 Data Interpretation:** Line Graphs

Text Book: Quantitative Aptitude by Dr. R.S.Agarwal

KAKATIYA UNIVERSITY
U.G. B.Sc. Final Year (Under CBCS)
Semester – VI: Generic Elective Paper-II
(FOR ALL SCIENCE FACULTY DEPARTMENTS)

WATER RESOURCES MANAGEMENT

UNIT-I

1. Importance of Natural Resources – Different Types Resources
2. Significance of Water Resources and their uses
3. Conservation of water and recycling of the water – Global distribution of water
4. Water shed programmes and their management
5. Storing the rain water in tanks and recharging ground water.

Unit-II

6. Rain water harvesting in rural areas (chekdam, trenches etc.,)
7. Over use of surface and ground water and control measures.
8. Aims, objectives and implementation of Mission Bhagiratha (Telangana Government Drinking water programme)
9. Aims, objectives and implementation of Mission Kakatiya (Telangana Government minor irrigation programme)
10. Issues and challenges in Water Resources Management

KAKATIYA UNIVERSITY
U.G. CHEMISTRY (Under CBCS)
B.Sc. Final Year (DSC-1F)
SEMESTER – VI

DSC-VI (T): CHEMISTRY PAPER-VII
(03 Hrs per week, 03 Credits) 45 Hrs

Unit-I (Inorganic Chemistry)	11Hrs
S6-I-1: Inorganic reaction mechanisms	04 Hrs
Labile and inert complexes, Thermodynamic and kinetic stability based on VBT & CFT: ligand substitution reactions – S_N1 and S_N2 in Octahedral complexes; substitution reactions of square planar complexes – Trans effect and applications of trans effect. Reactions of tetrahedral complexes - Hydrolysis of silicon halides and phosphorous oxides.	
S6-I-2: Bio inorganic chemistry	05 Hrs
Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride ion. Toxic metal ions As, Hg & Pb	
Oxygen transport and storage – structure of hemoglobin, binding and transport of oxygen. Fixation of CO_2 in photosynthesis- overview of light and dark reactions in photosynthesis. Structure of chlorophyll and coordination of magnesium. Electron transport in light reactions from water to $NADP^+$ (Z – scheme).	
S6-I-3: Hard and soft acids bases (HSAB)	02Hrs
Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of reaction.	
UNIT - II (Organic Chemistry)	11 Hrs
S6-O-1: Carbohydrates	06 Hrs
Introduction: Classification and nomenclature – classification into mono, oligo and polysaccharides, into pentoses, hexoses <i>etc.</i> , into aldoses and ketoses. Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structural elucidation: Evidences for straight chain pentahydroxy aldehyde structure (Acetylation, reduction to n-hexane, cyanohydrins formation, reduction of Tollen's and Fehling's reagents and oxidation to gluconic and saccharic acids). Number of optically active, isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (No proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehyde tests and mutarotation). Cyclic structure of glucose: Proposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair conformational formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane) Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure, Haworth formula).	
Inter Conversion of Monosaccharides: Aldopentose to aldo hexose – eg: Arabinose to D-glucose, D- mannose (kiliani – Fischer method). Epimers, Epimerisation- Lobry de bruyn van Ekenstein rearrangement. Aldohexose – Aldopentose eg: D-glucose to D-arabinose by Ruff's degradation. Aldohexose(+) (glucose) to ketohexose (-)(Fructose) and Ketohexose (Fructose) to aldohexose (Glucose).	

S6-O-2: Amino acids and proteins**05 Hrs**

acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and Leucine) by following methods: a) From halogenated Carboxylic acid b) Malonic ester synthesis c) strecker's synthesis. Physical properties: Optical activity of naturally occurring amino acids: L – configuration, irrespective of sign of rotation. Zwitter ion structure – salt like character, solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups – Lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins, peptide synthesis.

Unit-III (Physical Chemistry)**11 Hrs****S6-P-1: Thermodynamics –I****11 Hrs**

A brief review of - Energy, work and heat units, mechanical equivalent of heat, definition of system, surroundings. I law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function, path functions energy as a state function, and exact differential. Work of expansion and heat absorbed as path function. Expression for work of expansion, sign convention problems on I law. Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation $C_p - C_v = R$.

Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment and Joule-Thompson coefficient. Adiabatic changes in ideal gas derivation of equation, $PV = \text{constant}$. P-V curves for isothermal and adiabatic processes. Heat of a reaction at constant volume and at constant pressure, relation between H and V . Variation of heat of reaction with temperature. Kirchhoff's equation and problems. Limitations of I law and need for II law. Statement of II law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine problems. Thermodynamic scale of temperature.

Unit-IV (General Chemistry)**12 Hrs****S6-G-1: Proton Magnetic Resonance Spectroscopy****04 Hrs**

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations. ^1H NMR spectrum of – ethyl bromide, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.

S6-G-2: Mass Spectrometry**04 Hrs**

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular weight Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

S6-G-3: Thermodynamics- II**04 Hrs**

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non-spontaneous processes & equilibrium processes. Entropy changes in i). Reversible isothermal process, ii). Reversible adiabatic process, iii). phase change, iv). reversible change of state of an ideal gas. Problems. Entropy of mixing inert perfect gases. Free energy Gibb's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and net work G as criteria for

spontaneity. Derivation of equation $G = H - TS$. significance of the equation. Gibbs equations and the Maxwell relations. Variation of G with P, V and T.

References :

Unit- I

1. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001).
2. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn. (2006)
3. Metal Ions In Reaction mechanisms, K.Veera Reddy. Galgotia Publications Pvt Ltd(2004)

Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninth edition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers Pvt Ltd (2008)
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by Bruice Yuranis Powla. 2nd Edition (2012)

Unit III

1. Principles of physical chemistry by Prutton and Marron. The Macmillan Company; 4th edition (1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand & sons.(2011)
3. Text Book of Physical Chemistry by Puri, Sharmaand Pattania. chand and Co.(2017)
4. Physical Chemistry by Atkins & De Paula, 8th Edition, 2009
5. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
6. Physical Chemistry through problems by S.K. Dogra. (2015)
7. Text Book of Physical Chemistry by R.P. Verma.
8. Elements of Physical Chemistry byLewis Glasstone. Macmillan (1966)
9. Thermodynamics by Rajaram, Vishal Publishing Co,(2013)

Unit IV

1. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001).
2. Organic Spectroscopy, William Kemp Palgrave Macmillan; 2nd Revised edition edition (1 February 1987)
3. Principles of physical chemistry by Prutton and Marron.(The Macmillan Company; 4th edition (1970)
4. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand & sons.(2011).
5. Text Book of Physical Chemistry by Puri,Sharmaand Pattania. chand and Co.(2017)
6. Thermodynamics by Rajaram. Vishal Publishing Co,(2013)

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SEMESTER – VI

LABORATORY COURSE
DSC-VI (P): CHEMISTRY-VII (Physical Chemistry-II)
(03 Hrs per week, 01 Credit) 45 Hrs

I. Distribution law

1. Determination of distribution coefficient of iodine between water and carbon Tetrachloride/determination of molecular status and partition coefficient of benzoic acid in Toluene and water.
2. Determination of distribution coefficient of acetic acid between n-butanol and water.

II. Electrochemistry

1. Determination of cell constant of conductivity cell.
2. Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.
3. Determination of solubility and solubility product of $BaSO_4$

III. Colorimetry

1. Verification of Beer's - Lambert's law for $KMnO_4$ and determine the concentration of given solution.

IV. Adsorption

1. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

V. Physical constants

1. Surface tension and viscosity of liquids.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

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SEMESTER – VI

ELECTIVE - A

DSE-IIA (T): MEDICINAL CHEMISTRY

(03 Hrs per week, 03 Credits) 45 Hrs

Unit- I: Introduction and Terminology **11Hrs**

S6-E-A-I: Diseases: Common diseases, infective diseases–insect borne, air-borne, water-borne and hereditary diseases.

Terminology in Medicinal Chemistry: Drug, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, anti metabolites and therapeutic index.

Drugs: Nomenclature: Chemical name, Generic name and Trade names with examples; Classification: Classification based on structures and therapeutic activity with examples.

ADME: a) Absorption: Definition, absorption of drugs across the membrane – active and passive absorption, routes of administration of drugs. b) Distribution: definition and effect of plasma protein binding. c) Metabolism: definition, phase I and phase II reactions. d) Elimination: definition and renal elimination.

Unit-II: Enzymes and Receptors **11Hrs**

S6-E-A-II: Enzymes: Introduction. Mechanism and factors affecting enzyme action, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance. Types of inhibition - reversible, irreversible and their subtypes with examples.

Receptors: Introduction, Drug action-receptor theory, Mechanism of drug action, concept of agonists and antagonists with examples. Drug receptor interactions involved in drug receptor complex. binding role of –OH group, -NH₂ group, quaternary ammonium salts and double bond. Structure – activity relationships of drug molecules, explanation with sulfonamides.

Unit- III: Synthesis and Therapeutic Activity of Drugs **12Hrs**

S6-E-A-III: Introduction, synthesis and therapeutic activity of :

Chemotherapeutics: Sulphanilamide, dapsone, Pencillin-G (semi synthesis), Chloroquin, Isoniazid, Cisplatin and AZT.

Drugs to treat metabolic disorders: Anti diabetic - Tolbutamide; Antiinflammatory – Ibuprofen; Cardiovascular- Glyceryl trinitrate; Antipyretic (paracetamol, aspirin) and Antacid-Omeprazole.

Drugs acting on nervous system: Anesthetics-definition, Classification-local and general. Volatile- Nitrous oxide, chloroform uses and disadvantages. Local anesthetics – benzocaine.

Unit- IV: Molecular Messengers and Health Promoting Drugs **11Hrs**

S6-E-A-IV: Molecular Messengers: Introduction to hormones and neurotransmitters, Thyroid hormones, Antithyroid drug-Carbimazol. Adrenaline: Adrenergic drugs- salbutamol, atenelol. Serotonin: SSRIs- fluoxetine. Dopamine: Antiparkinson drug- Levodopa .

Health promoting drugs: Introduction, sources, Deficiency disorders and remedy of Vitamins A,B, C, D, E, K and micronutrients – Na, K, Ca, Cu, Zn and I .

Reference books

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, New York. 2013.
2. Thomas Nogrady, Medicinal Chemistry, Oxford Univ. Press, New York.2005.
3. David William and Thomas Lemke, Foye’s Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 2008.
4. Ashutosh Kar Medicinal Chemistry, New Age International, 2005.
5. O.D.Tyagi & M.Yadav Synthetic Drugs by, Anmol Publications,1998.
6. Medicinal Chemistry by Alka L. Gupta, Pragati Prakashan.
7. G. L. David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K. L. N. Reddy, C. Sudhakar, Drugs, Universities Press (India) Ltd. 2012.

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SEMESTER – VI

ELECTIVE - A

LABORATORY COURSE
DSE: CHEMISTRY LAB –VIII
(Qualitative analysis of Organic Compounds)
(02 Hrs per week, 01 Credit) 30 Hrs

I. Qualitative Analysis of Organic Compounds

Identification of an organic compound through the functional group analysis. Determination of melting point and preparation of suitable derivatives.

Reference Books:

1. Vogel A I, Tatchell A R, Furnis B S, Hannaford A J & Smith P W G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

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SEMESTER – VI

ELECTIVE-B

DSE-IIB (T): AGRICULTURAL AND FUEL CHEMISTRY

(03 Hrs per week, 03 Credits) 45 Hrs

Unit I: Pesticides

12Hrs

S6-E-B-I: Introduction, Definition, classification of pesticides based on use (target). Toxicity and chemical structure with examples. Adverse effects of pesticides and its impact on environmental pollution. Synthesis, technical manufacture and uses of representative pesticides in the following classes: Organochlorines (Cypermethrin); Organophosphates (Parathion); Carbamates (carbaryl); Quinones (Chloranil), Anilides (Alachlor).

Pesticide formulations: Dusts, Granules, Wettable powders, Emulsions and Aerosols.

Biopesticides : Introduction: Potential pesticidal plants of India, Role of Neem in plant protection-constituents, Azadirachtin and its role in pest control, Structure and mode of action of Pyrethrins(pyrethrin-1) and Pyrethroids (permethrin) and nicotinoids (Imidacloprid).

Unit II: Fertilizers

11Hrs

S6-E-B-II: Introduction: (need of fertilizers), functions of essential plant nutrients (N, P, K), Classification formula and uses of fertilizers:

Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride and their uses.

Phosphate fertilizers: Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate and their uses.

Potassium fertilizers: Potassium chloride, potassium nitrate, potassium sulphate and uses.

Complex fertilisers: Diaammonium Phosphate and mixed fertilizers their uses. Manufacture of urea and Super phosphate of lime and their reactions in the soil.

Biofertilizers: Introduction, definition, classification, Rhizobium, Azatobactor, Azospirillum, Azolla, Blue Green Algae, Vermicomposting and uses.

Organic farming: The principal methods, crop rotation, green manures and compost, biological pest control, and mechanical cultivation and uses.

Unit III: Energy Sources and Coal

11Hrs

S6-E-B-III: Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Unit IV: Petroleum, Petrochemical Industry and Lubricants

11Hrs.

S6-E-B-IV: Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation - Principle and process, Cracking -Thermal and catalytic cracking, Reforming of Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene and their uses.

Lubricants: Classification of lubricants, Properties and functions of lubricants (viscosity index, point, pour point) and their determination. Lubricating oils (conducting and nonconducting) Solid and semisolid lubricants, synthetic lubricants.

Reference books:

1. N. N. Melnikov, Chemistry of pesticides; Springer-Verlag- Technology & Engineering (2012).
2. Thomas A. Unger Pesticide Synthesis Handbook; Elsevier, (2000).
3. R. Cremlyn Pesticides; John Wiley, 1980.
4. A. K. Kolay Manures and Fertilisers; Published by Atlantic (2007).
5. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
6. Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.
7. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

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B.Sc. Final Year (DSC-1F)
SEMESTER – VI

Elective-B

LABORATORY COURSE

DSE: CHEMISTRY LAB –VIII

(Synthesis of Drugs & Organic Compounds)

(02 Hrs per week, 01 Credit) 30 Hrs

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbituric Acid
5. Preparation of Antipyrine

Reference Books:

1. Medicinal Chemistry, Ashutoshkar, New Age International Ltd
2. Vogel's Text book of Organic Chemistry

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SEMESTER – VI

Elective-C

CHEMISTRY PAPER-VIII
DSE: GREEN CHEMISTRY
(03 Hrs per week, 03 Credits) 45 Hrs

UNIT-I **11Hrs**

S6-E-C-1: Introduction of Green Chemistry

Introduction- Definition of green Chemistry, need of green chemistry, basic principles of green chemistry. Green synthesis- Evaluation of the type of the reaction i) Rearrangements (100% atom economic), ii) Addition reaction (100% atom economic). Organic reactions by Sonication method: apparatus required examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).

UNIT-II **11 Hrs**

S6-E-C-2: Selection of Solvent

i) Aqueous phase reactions ii) Reactions in ionic liquids, Heckreaction, Suzuki reactions, epoxidation. iii) Solid supported synthesis

Super critical CO₂: Preparation, properties and applications, (decaffeination, dry cleaning)

UNIT-III **11Hrs**

S6-E-C-3: Microwave and Ultrasound assisted green synthesis

Apparatus required, examples of MAOS (synthesis of fused Anthraquinone, Leukart reductive amination of ketones) - Advantages and disadvantages of MAOS. Aldol condensation-Cannizzaro reaction-Diels-Alder reactions-Strecker's synthesis

UNIT-IV **12 Hrs**

S6-E-C-4: Examples of green synthesis / reactions and some real world cases:

1. Green synthesis of the following compounds: adipic acid , catechol , disodium imino di acetate (alternative Strecker's synthesis)

2. Microwave assisted reaction in water – Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols – microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction.

3. Ultrasound assisted reactions – sonochemical Simmons –Smith reaction (ultrasonic alternative to iodine)

Reference books

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia., Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
5. Green Chemistry: Introductory Text, M.Lancaster
6. Principles and practice of heterogeneous catalysis, Thomas J.M., Thomas M.J., John Wiley
7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications.

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SEMESTER – VI

Elective-C

LABORATORY COURSE

DSE: CHEMISTRY LAB –VIII (Preparation of Organic Compounds by Green Methods)

(02 Hrs per week, 01 Credit) 30 Hrs

1. Acetylation of 1^o amine by green method: Preparation of acetanilide
2. Rearrangement reaction in green conditions: Benzil-Benzilic acid rearrangement
3. Electrophilic aromatic substitution reaction: Nitration of phenol
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipic acid
6. Green procedure for Diels Alder reaction between furan and maleic anhydride

Reference Books:

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
5. Green Chemistry: Introductory Text, M.Lancaster
6. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications