FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. Applied Chemistry (Pharmaceuticals)
(Credit Based Evaluation & Grading System)
(Semester: I - IV)

Examinations: 2019-20

GURU NANAK DEV UNIVERSITY
AMRITSAR

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(ii) Subject to change in the syllabi at any time.
     Please visit the University website time to time.
Course Scheme

Note: All Theory Papers having Mid Semester Marks: 20 & End Semester Marks: 80. Total Marks will be 100.

First Semester

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Code</th>
<th>Theory Papers</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CYL471</td>
<td>Organic Synthesis-I</td>
<td>3-0-0</td>
</tr>
<tr>
<td>2.</td>
<td>CYL472</td>
<td>Physical Chemistry-I</td>
<td>3-0-0</td>
</tr>
<tr>
<td>3.</td>
<td>CYL473</td>
<td>Inorganic Chemistry-I</td>
<td>3-0-0</td>
</tr>
<tr>
<td>4.</td>
<td>CYL474</td>
<td>Organic Spectroscopy</td>
<td>3-0-0</td>
</tr>
<tr>
<td>5.</td>
<td>CYL475</td>
<td>Biological Chemistry</td>
<td>3-0-0</td>
</tr>
<tr>
<td>6.</td>
<td>CYL476</td>
<td>Pharmaceutical Processing and Technology</td>
<td>3-0-0</td>
</tr>
<tr>
<td>7.</td>
<td>CYP471</td>
<td>Instrumental Technique Lab-I</td>
<td>0-0-3</td>
</tr>
<tr>
<td>8.</td>
<td>CYP472</td>
<td>Organic Synthesis Lab</td>
<td>0-0-3</td>
</tr>
</tbody>
</table>
# Second Semester

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Code</th>
<th>Theory Papers</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CYL481</td>
<td>Chemical Engineering-I</td>
<td>3-0-0</td>
</tr>
<tr>
<td>2.</td>
<td>CYL482</td>
<td>Organic Synthesis-II</td>
<td>3-0-0</td>
</tr>
<tr>
<td>3.</td>
<td>CYL483</td>
<td>Physical Chemistry-II</td>
<td>3-0-0</td>
</tr>
<tr>
<td>4.</td>
<td>CYL484</td>
<td>Modern Instrumental and Spectroscopic Techniques</td>
<td>3-0-0</td>
</tr>
<tr>
<td>5.</td>
<td>CYL485</td>
<td>Medicinal Chemistry-I</td>
<td>3-0-0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Interdisciplinary course</td>
<td>4-0-0*</td>
</tr>
<tr>
<td>7.</td>
<td>CYP481</td>
<td>Instrumental Technique Lab-II</td>
<td>0-0-3</td>
</tr>
<tr>
<td>8.</td>
<td>CYP482</td>
<td>Pharmaceutical and Natural Products Lab</td>
<td>0-0-3</td>
</tr>
</tbody>
</table>

*Interdisciplinary courses can be chosen from the four credit ID courses (PG) offered by the following departments:

1. Department of Bio-Technology  
2. Department of Botanical Sciences  
3. Department of Food Science and Technology  
4. Department of Microbiology  
5. Department of Molecular Biology and Bio-chemistry  
6. Department of Pharmaceutical Sciences

**Note:** PSL-053 ID Course Human Rights & Constitutional Duties (Compulsory Paper). Students can opt. this paper in any semester except the 1st Semester. This ID Paper is one of the total ID Papers of this course.
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER SYSTEM)
(Credit Based Evaluation & Grading System)

Third Semester

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Code</th>
<th>Theory Papers</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CYL571</td>
<td>Chemical Engineering-II</td>
<td>3-0-0</td>
</tr>
<tr>
<td>2.</td>
<td>CYL572</td>
<td>Medicinal Chemistry-II</td>
<td>3-0-0</td>
</tr>
<tr>
<td>2.</td>
<td>CYL573</td>
<td>Inorganic Chemistry-II</td>
<td>3-0-0</td>
</tr>
<tr>
<td>3.</td>
<td>CYL574</td>
<td>Drug Design and Drug Development</td>
<td>4-0-0</td>
</tr>
<tr>
<td>4.</td>
<td>CYL575</td>
<td>Photochemistry and Pericyclic reactions</td>
<td>3-0-0</td>
</tr>
<tr>
<td>5.</td>
<td>CYL576</td>
<td>Process Control and Plant Economics</td>
<td>3-0-0</td>
</tr>
<tr>
<td>6.</td>
<td>CYL577</td>
<td>Green Chemistry and Waste Treatment</td>
<td>3-0-0</td>
</tr>
<tr>
<td>7.</td>
<td>CYP571</td>
<td>Pharmaceutical and Biological Chemistry Lab</td>
<td>0-0-3</td>
</tr>
<tr>
<td>8.</td>
<td>CYP572</td>
<td>Analytical Lab</td>
<td>0-0-3</td>
</tr>
</tbody>
</table>

Course Scheme for Fourth Semester

The fourth semester will comprise of a dissertation of 16 credits to be executed in pharmaceutical/chemical industry. The credits of the fourth semester will be distributed as

1. Project report and Evaluation by Industrial supervisor 16-0-0
   The industrial supervisor will be award the performance of candidate as Excellent, Good or Average based on the following criteria:
   - Regularity of the candidate
   - Understands the nature, objective and scientific principles underlying the investigation
   - Familiar and understands the relevant literature
   - Comprehends appropriate techniques and analytical methods
   - Correctly interprets results and clearly explains research findings
   - Assesses the significance of findings in a thorough, logical and coherent manner
   The candidate will give an open presentation of the project work in the department.

2. The candidate will give a Seminar, the topic of which will be decided by the department. 4-0-0
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-I)
(Credit Based Evaluation & Grading System)

Organic Synthesis-I
CYL – 471

Credit 3-0-0

Time: 3 Hours                                                                                                     Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20\% weightage
End Semester Examination: 80\% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
1. Reaction Mechanism: Structure and Reactivity (12 Hrs)
   Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond’s postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity- resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants.Taft equation.

Section-B
2. Aliphatic Nucleophilic Substitutions (10 Hrs)
The $S_{N2}$, $S_{N1}$, missed $S_{N1}$ and $S_{N2}$ and SET mechanisms.
The neighbouring group mechanism, neighbouring group participation by $\pi$ and $\sigma$ bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The $S_{Ni}$ mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transferr catalysis and ultrasound, ambident nucleophile, regioselectivity. Gabriel synthesis
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-I)
(Credit Based Evaluation & Grading System)

Section-C

3. Aromatic Nucleophilic Substitution
   (5 Hrs)
   The $S_{\text{NAr}}$, $S_{\text{N1}}$, benzyne and $S_{\text{RN1}}$ mechanisms, Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements.

4. Elimination Reactions
   (6 Hrs)
   The E2, E1 and E1cB mechanisms and their stereochemistry. Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

Section-D

5. Aliphatic Electrophilic Substitutions
   (5 Hrs)
   *Bimolecular mechanisms* - $S_{\text{E2}}$ and $S_{\text{E1}}$. The $S_{\text{E1}}$ mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity, Hell-Volard-Zelinsky reaction.

6. Aromatic electrophilic substitution
   (7 Hrs)
   The arenium ion mechanism, orientation and reactivity in mono substitution and di-substituted aromatics, energy profile diagram, the ortho/para ratio, ipso attack, orientation in other ring systems, quantitative treatment of reactivity in substrates and electrophiles. Diazoc coupling, Vilsmeir reaction, Gatterman-Koch reaction, Bechmann reaction, Hoben-Hoesch reaction.

Books Recommended:
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-I)
(Credit Based Evaluation & Grading System)

Physical Chemistry-I
CYL-472
Credit 3-0-0

Time: 3 Hours
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
1. Chemical Thermodynamics (12Hrs)
Laws, state and path functions and their applications, thermodynamics description of various types of processes, Concepts of free energy, entropy, fugacity and activity. Partial molar properties and their determination. Maxwell’s relations, spontaneity and equilibria, temperature and pressure dependence of thermodynamics quantities, Le Chatelier principle, elementary description of phase transitions, phase equilibria and phase rule, two component system and three component system with one example each, Thermodynamics of ideal and non ideal mixtures, dilute solutions, excess functions. Activity coefficients of electrolytes, mean ionic activity coefficient, Debye Huckle treatment of dilute electrolyte solutions. Numerical Problems

Section-B
2. Statistical Thermodynamics: (10Hrs)

Section-C
3. Chemical Kinetics (12 Hrs)
4. Surface Chemistry and Catalysis (11Hrs)

Books Recommended:
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-I)
(Credit Based Evaluation & Grading System)

Inorganic Chemistry-I
CYL-473

Credit 3-0-0
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Time: 3 Hours
Max. Marks: 100
Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
1. Reaction Mechanism of Transistion Metal Complexes (10Hrs)
Introduction, ligand replacement reactions, classification of mechanisms, Water exchange rates, formation of complexes from aqueous ions, anation, reaction, aquation and base hydrolysis attack on ligands, reactions, of square planar complexes, mechanism of ligand- displacement reactions; metal carbonyl reactions, reactions of binuclear carbonyls, associative reactions, species with 17 electron, electron transfer processes outer and inner sphere. The Marcus theory, doubly bridged inner-sphere transfer, other electron transfer reactions; two electron transfers, Non-complementary reaction, Ligand exchange via electron exchange, reductions by hydrated electrons, stereochemical non-rigidity, stereochemically non-rigid coordination compounds,

Section-B
2. Organometallic Chemistry: (12Hrs)
The basis of 18e- Rule, Exceptions to eighteen electron rule, Preparation of olefin Transition Metal Complexes.Molecular orbital, Description of bonding of two electron ligands to Transition Metals.Preparation of \( \pi \)-enyl complex, Molecular orbital description of ligands to transition metals, Molecular orbital picture of bonding in ferrocene, Organic Chemistry of cyclopentadienyl Transition Metal Complexes, preparation of bis \( \pi \)-arene complexes, Bonding of Bisarene complexes,

Section-C
3. Bioorganometallic Chemistry And Organocatalysed Coupling Reactions: (12Hrs)
Bioorganometallic Chemistry. Enzymes that contain organometallic active site and the enzymes that catalyze organometallic reactions, Metals and Health: Part I - Metal-based drugs (cis-platin, carboplatin, platinum anti-cancer drugs, technetium radiopharmaceuticals, gadolinium MRI contrast agents, auranofin). Part II - Metal toxicity: iron overload, mercuric ion reductase, lead and porphobilinogen synthase.
Section-D

4. Organometallic reagents in organic Synthesis: (11 Hrs)
Oxidative Coupling, Reductive Elimination, Migration Insertion, β-Elimination, Combined Problems based on these mechanistic pathways, Catalysis involving metal complex intermediates. Organopalladium catalysed Coupling Reactions: Suzuki Coupling, Stille Coupling, Sonogashira coupling, Heck Coupling, Hyama Coupling, Negishi Coupling and Kumada Coupling

Books Recommended:

Organic Spectroscopy
CYL-474
Credit 3-0-0

Time: 3 Hours
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

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Section-A
1 Nuclear Magnetic Resonance Spectroscopy-I (12Hrs)
Basic Introduction, Fundamentals: Physical basis, magnetic nuclei, resonance, relaxation processes, signal-sensitivity.b) Instrumentation: Continuous-Wave (CW) instrument, Pulsed Fourier Transform (FT) instrument, Functions, Relation with sensitivity, Sampling. $^1$H NMR, correlation of structure with spectra: Chemical environment and shielding, chemical shift and origin of its concept, reference compound, local diamagnetic shielding and magnetic anisotropy, relation with chemical shift, chemical and magnetic-non-equivalence, spin-spin splitting and its origin, Pascal's triangle, coupling constant, mechanism of coupling, integral, NMR solvents and their residual peaks, protons onheteroatoms, quadrupole broadening and decoupling, effect of conformations and stereochemistry on the spectrum, Karplus relationship, diastereomeric protons, Heteronuclear coupling to F and P, virtual coupling, long range coupling-epi, peri, bay effects. Shift reagents-mechanism of action, spin decoupling and double resonance.

Section-B
2 Nuclear Magnetic Resonance Spectroscopy-II (6Hrs)
$^{13}$C NMR, correlation of structure with spectra: Chemical environment, shielding and carbon-13 chemical shift, calculation, proton-coupled C Spectra, Proton-decoupled C spectra, Nuclear Overhauser Enhancement (NOE), Problem with integration, Distortion-less Enhancement by Polarization Transfer (DEFT), Heteronuclear coupling for carbon to deuterium, carbon to F, carbon to P. Explanation of spectra of some compounds and drugs.
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-I)
(Credit Based Evaluation & Grading System)

3 UV/Visible Spectroscopy (5Hrs)
Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra, Chromophores, auxochromes, blue shift, red shift, hypo and hyperchromic effect, n-σ*, π-π*, n-π* transitions in organic molecules. Woodward rules for conjugated dienes and -unsaturated carbonyl groups, extended conjugation and aromatic sterically hindered systems

Section-C

4 Infrared and Mass Spectroscopy: (11Hrs)
Characteristic regions of the spectrum: Various modes of vibrations, Energy levels Correlation of structure with IR spectra: Influence of substituents, ring size, hydrogen bonding, vibrational coupling and field effect on frequency, Absorptions of common functional group, Molecular ion and metastable peak, fragmentation patterns, nitrogen and ring rules, McLafferty rearrangement, electron and chemical ionization modes

Section-D

5. Interpretation of Organic Compounds and Drugs Using NMR/UV Visible/IR/Mass Spectroscopy (11Hrs)
(a) Combined problems on NMR/IR/UV-Visible Spectroscopy
(b) Combined problems on Mass and NMR
(c) Combined problems on NMR/UV/IR and Mass Spectroscopy.

Books Recommended:
1. Pavia, Lampman&Kriz, Introduction to Spectroscopy.
2. C.N Banwell "Fundamentals of Molecular Spectroscopy".
4. W. Kemp, "Organic Spectroscopy".
8. G.M. Barrow "Introduction to Molecular Spectroscopy".
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-I)
(Credit Based Evaluation & Grading System)

Biological Chemistry
CYL-475
Credit 3-0-0

Time: 3 Hours  
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

1. Bio-molecules (2 Hrs)
  Broad classification and role of biomolecules.

2. Amino Acids and Proteins (10 Hrs)

Section-B

3. Enzymes (7Hrs)

4. Carbohydrates and Metabolism (4Hrs)
  Configuration and chemical Transformations of Carbohydrates. Absolute configuration of carbohydrates. General concepts, energetics and control on metabolic pathways. Glycolysis and Citric acid cycle.

Section-C

5. Co-enzymes (11Hrs)
Section-D

6. Biotechnological Application of Enzymes (11Hrs)
Large scale production and purification of enzymes, techniques and method of immobilization of enzymes, effect of immobilization on enzyme activity, Application of immobilized enzymes, use of enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

Books Recommended:

Pharmaceutical Processing and Technology
CYL – 476
Credit 3-0-0

Time: 3 Hours
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

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Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

(A) Pharmaceutical Processing (3Hrs)
1. Milling : Objectives of comminution factors affecting size reduction, processes of milling, theory of milling and energy requirements, milling rate and types of milling machines, size distribution, determination of size, microscopy, sieving and sedimentation of particles. Pharmaceutical applications of milling

2. Mixing and Homogenisation (3Hrs)
Fluid mixing mechanisms and equipment, their classification and feasibility of selection based upon Reynolds, Froude and power numbers; Equipment for solid mixing. Study of following mixers; planetary mixer, agitator, triple roller mill, propellor mixer, Pharmaceutical applications of Mixing.

3. Compression and Consolidation of Pharmaceutical Powders (4Hrs)
Definition, angles of repose, Flow rate through tubes and hoppers, mass - volume – force relationship. Granulation properties and strength of granules, compression and consolidation under high loads

Section-B

(B) Pharmaceutical dosage forms

4. Preformulation considerations (4Hrs)
Analytical methods for Characterization of drugs, determination of PKa value, pH solubility profile and effect of temperature, stability, calculation of shelf life.

5. i) Processing of tablets (4hrs)
Advantages and disadvantages of tablets, types of tablets. Granulation – manufacture of granules, their basic characteristics and properties with reference to different types of substances. Various additives included in tablet formulations. Compression of tablets - compressing machines and their tooling, processing problems and their remedy. Evaluation of tablets as per official standards.
ii) Tablet coating (3Hrs)

Section-C

6. Processing of Capsules (4hrs)

7. Microencapsulation (4Hrs)
Importance and applications of microencapsulation in Pharmacy. Various techniques and equipment employed for microencapsulation.

8. Sustained release dosage forms (4Hrs)

Section-D

9. Liquid dosage forms: Types, advantages and disadvantages.
   a) Monophasic liquid dosage forms: (2Hrs)
   Techniques of increasing solubility of drugs, other problems involved in preparation and stability of liquids.
   b) Biphasic liquid dosage forms: (2Hrs)
   ii) Emulsions: Advantages of emulsion dosage form, types, identification, selection of emulsifying agents, Preparation, Calculation of $x^2B$ value and stability studies.

10. Semi-solid dosage forms (2Hrs)
A brief review of the preparation of ointments, creams and suppositories.

11. Pharmaceutical aerosols (3hrs)
Advantages of aerosol dosage form. Formulation of aerosol products and their standardization.

1. Importance of Monographs: (3 hrs)

Books Recommended:
Experiments
1. Verification of Bernoulli's theorem.
2. Determination of Thermal conductivity (Metal Bar).
3. Determination of thermal conductivity of Insulating powers.
5. Determination of coefficient of discharge by orifice meter.
6. To determine the friction factor for given pipe and Chezy’s constant and Maning’s constant.
7. Study of turbulent flow through pipes.
8. Study of Laminar flow.
10. Study of friction-losses in pipe lines, joints and bends.
11. To determine coefficient of contraction (CC), coefficient of velocity (CV) and coefficient of discharge (Cd) for circular / rectangular orifices.
13. Determination of total hardness, total alkalinity and chloride content of water.
14. Distribution of solute between two immiscible solvents.
16. To determine the rate constant of a reaction between ethyle acetate and caustic soda solution at two different temperatures and energy of activation.
17. Study the effect of catalyst on the decomposition of hydrogen peroxide.
18. Study the phase diagram of Naphthalene and Benzoic acid.
19. Determination of consolute points (Upper or Lower or both).
20. Construct a phase diagram of 3-component system.

Books recommended:
10. Findlay's Practical Physical Chemistry.
11. Advanced Practical Physical Chemistry by J.B. Yadav.
12. Laboratory Handbook for Oil & Fat Analysis by L.V. Cock and C. van Rede.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Experiment</th>
<th>Chemicals required</th>
<th>Apparatus</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepare a sample of Ibuprofen and record its $^1\text{H}$, $^{13}\text{C}$ NMR spectra</td>
<td>Aspirin, methanol, sulphuric acid</td>
<td>Rbf, reflux condenser / microwave oven</td>
<td><em>J. ChemEdu.</em>, 2009, 86, p475</td>
</tr>
<tr>
<td>5</td>
<td>Dihydroxylation of cyclohexene with peracids and KMnO$_4$ – Product distribution by TLC</td>
<td>2,4,6-trimethylaniline, 40% glyoxal in water, ethanol, p-formaldehyde, toluene, HCl, dioxane, silver(1)oxide, dichloromethane</td>
<td>Rbf, stirrer, reflux condenser, filtration, rotavapor</td>
<td><em>J. ChemEdu.</em>, 2008, 85, p416</td>
</tr>
<tr>
<td>6</td>
<td>Solvent free Cannizaro reaction using p-nitrobenzaldehyde</td>
<td>Bromobenzene, Mg, anhydrous ether, acetophenone, amm. chloride</td>
<td>Two necked Rbf condenser, dropping funnel, separatory funnel, drying tube,</td>
<td><em>Modern projects and experiments in organic chemistry</em> By Jerry R. Mohrig, Christina N. Hammond, Paul F. Schultz, Terence C. Morill, 2nd Ed, 2003, p124</td>
</tr>
<tr>
<td></td>
<td>Project</td>
<td>Details</td>
<td>Reference</td>
<td></td>
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<td>-------------------------------------------------------------------------</td>
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<tr>
<td>9</td>
<td>Reduction of 3-nitroacetophenone using i) NaBH₄ ii) using Sn and HCl. Identification of the products with NMR, UV, IR spectra</td>
<td>3-Nitroacetophenone, Sn, HCl, absolute ethanol, sodium hydroxide, sodium borohydride</td>
<td><em>Modern projects and experiments in organic chemistry. P193</em></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Synthesis of N,N-diethyl-m-toluamide (mosquito repellent) from m-toluic acid</td>
<td>m-Toluic acid, thionyl chloride, anhydrous ether, diethyl amine</td>
<td><em>Modern projects and experiments in organic chemistry. P 227</em></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Synthesis of Aspirin, its mode of action and molecular modeling with cyclooxygenase</td>
<td>Salicylic acid, acetic anhydride</td>
<td><em>Modern projects and experiments in organic chemistry. P 29</em></td>
<td></td>
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<tr>
<td>12</td>
<td>Isolation of essential oils from Caraway seeds and orange peels – (S) – Carvone and (R) - Limonene</td>
<td>Caraway seeds (Shah Jeera)</td>
<td><em>Modern projects and experiments in organic chemistry. P 40</em></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Synthesis of styrene epoxide and ring opening reactions under neutral and acidic conditions</td>
<td>Styrene, m-CPBA, Rbf, stirrer, suction filtration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Introduction to chemical informatics</td>
<td></td>
<td><em><a href="http://www.ch.ic.ac.uk/local/organic/3.html">http://www.ch.ic.ac.uk/local/organic/3.html</a></em></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Molecular modeling – Reactivity of Diels-Alder reaction; Hydrogenation of cyclopentadiene dimer</td>
<td>Software – Gaussian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Diels – Alder reaction of a Danishefskydiene</td>
<td>Trans-4-methoxybutene-2-one, zinc chloride, triethyl amine, trimethylsilyl chloride, maleic anhydride/methyl vinyl ketone</td>
<td><em>J. Am. Chem. Soc., 1974, 96, 7807</em></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Synthesis and oxidation of 1-aminobenzotriazole – Benzyne trapping</td>
<td>o-nitroaniline, diethyl malonate, sodium nitrite, sodium acetate, Pd-C (10%), lead tetra-acetate,</td>
<td><em>J. Chem. Soc. (C), 1969, 742</em></td>
<td></td>
</tr>
</tbody>
</table>
Chemical Engineering-I
CYL – 481
Credit 3-0-0

Time: 3 Hours
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
1. Fluid Flow (6Hrs)
Types of fluids, Viscosity and its units, Reynolds Number, Bernoullis equation, concept of friction, friction factor, friction loss due to sudden enlargement and sudden contraction, Velocity distribution in pipes, Hagen-Poiseuille equation.

2. Mass Transfer (6Hrs)
Introduction, Fick’s Law, mass transfer in binary mixtures through a stationary gas, diffusion in liquids, mass transfer across a phase boundary, two film theory.

Section-B
3. Transportation of Fluids (11Hrs)
Different types of pumps; Positive Displacement Pumps, Reciprocating pump, Rotary Pump, Centrifugal Pumps, Cavitation Suction Head and Net Positive Suction Head, and types of valves, Flow meters; orificemeter, venturimeter, pitot tube, Rotameter, Notches.

Section-C
4. Heat Transfer (11Hrs)

Section-D
5. Measuring Instruments (11Hrs)
(a) Temperature Measurements: Solid rod thermometer, Bimetallic thermometer, Electric resistance thermometer, thermo electric sensors (Thermo couple).
(b) Viscosity Measurement: Capillary tube viscometer, Efflux type viscometer, rotating concentric cylinder viscometer, variable area viscometer.
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-II)
(Credit Based Evaluation & Grading System)

(c) **Specific gravity & Density measurement**: Bubbler system, hydrometer method, total immersed float method, Nuclear absorption method, Fixed volume method.

(d) **Liquid Level Measurement**: Dip stick method, Sight glass method, Hook Gauge, Float gauge.

(e) **Pressure Measurements**: Liquid column manometers, Elastic element pressure measurement devices, Pressure transducers.

**Books Recommended**:


M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-II)  
(Credit Based Evaluation & Grading System)

Organic Synthesis-II  
CYL – 482

Credit 3-0-0

Time: 3 Hours  
Max. Marks: 100
Mid Semester Marks : 20  
End Semester Marks : 80

Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage

Instructions for the Paper Setters:  
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

1. Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds  
(12Hrs)  

Section-B

2. Oxidation Reactions  
(6Hrs)  
Introduction. Different oxidative processes. Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzenediacetate and thallium (III) nitrate, DDQ, PCC, CAN, selenium dioxide, peroxyacids, DCC. Oxidation reactions with special emphasis on Baeyer-villegger reaction, Cannizarro oxidation-reduction reaction,
3. Rearrangements

General mechanistic consideration – nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schmidt, Shapiro reaction, Fries rearrangement

Section-C

4. Reduction Reactions


Section-D

5. Free Radical Reactions:


Books recommended:
Physical Chemistry-II
CYL – 483

Credit: 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks: 20
End Semester Marks: 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
1. Liquid State: (11Hrs)
Introduction to liquid state, thermodynamic properties of liquids, vapour pressure and its determination, enthalpy and entropy of vaporization, Trouton’s rule. Intermolecular forces, models and theories of liquids, surface and transport properties, surface tension and its measurement, viscosity and its measurement. Liquid crystals, smectic, nematic and cholestericmeso phases.

Section-B
2. Solid State: (11Hrs)
Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and planed effects, Schottky and Frenkel defects, colourcentres, non-stoichiometry and defects, solidstate reactions. Metals, insulators and semiconductors, intrinsic and extrinsic semi conductors, doping semiconductors, superconductors, magnetic materials (ferrites) and their classification.

Section-C
3. Electrochemistry of Solutions (12Hrs)
Ion-solvent interactions, the Born model, electrostatic potential at the surface of a charged sphere, Born expression far the free energy of ion-solvent interactions, structural treatment of ion-solvent interactions, ion-dipole moment, evaluation in the ion-dipole approach to heat of solvation, solvation number, static and dynamic pictures of ion-solvent interactions, hydration number, dielectric constant of water and ionic solutions, dielectric constant ofliquids containing associated dipoles, ion – solvent nonelectrolyte interactions, change insolubility of non-electrolyte due to primary and secondary solvations.
Section-D

4. Photochemistry (11 Hrs.)
Difference between thermal photochemical reactions, laws of photochemistry, Jablonsi diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (IC, ISC), quantum yield, photosensitized reactions, nuclear geometries of electronically excited states, energy surface description of molecular photochemistry. Excimers and Exciplexes, kinetics of photochemical reactions, chemiluminescence, solar energy conversion and storage.

Books Suggested:

CYL – 484 : Modern Instrumental and Spectroscopic Techniques

Credit 3-0-0
Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

1. Spectroscopic Techniques: (12 Hrs)
a) FT-NIR: Principle (overtones, combinations, fermi resonance, interferences etc.), instrumentation (dispersion spectrometer and FT-NIR), advantage and disadvantage, qualitative and quantitative applications, including PAT and non-destructive analysis.
b) ATR: Principle (total internal reflection, evanescent wave, etc.), instrumentation (ATR crystal, IR beam), advantages and disadvantages, pharmaceutical applications.
c) FT-Raman: Principle (absorption, diffraction, scattering and emission of wave, molecular interaction), instrumentation (Dispersive Raman, FT-Raman), advantage and disadvantage, pharmaceutical applications including detection of counterfeits.

Section-B

2. Thermal Techniques: (11 Hrs)
a) DSC: Principle, thermal transitions, instrumentation (Heat flux and powercompensation designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates resolution etc. source of errors) and their influence, advantages and disadvantages, pharmaceutical applications.
b) DTA: Principle, instrumentation, advantage and disadvantage, pharmaceutical application, derivative differential thermal analysis (DDTA).
c) TGA: Principle, instrumentation, factors affecting results, advantages and disadvantages, pharmaceutical application.

Section-C

3. Chromatographic Techniques: (10 Hrs)
a) HPLC: Principle, instrumentation, pharmaceutical applications.
b) UPLC: Principle and applications.
C) LC-MS and LC-NMR: Nature of interfaces, applications.
d) GC: Principle, instrumentations, pharmaceutical applications.
Section D

4. Quality Control and Quality Assurance (12Hrs)
Good manufacturing practices and its applications to pharmaceutical industry. Basic principles and concepts of quality management viz. quality control, quality assurance, quality auditing and ISO system etc. Sampling, finished products labeling, distribution records, Document control: Issuance, storage and retrieval, Standard operating procedures: Change control procedure and annual product review, Basic principles of validation: Validation protocols, analytical method validation and process validation, Technology transfer from R & D to manufacturing, Market complaint and handling of returned goods,

Books Recommended:
Section-A

1. Introduction to Pharmaceuticals (3Hrs)
Historical Development, Classification of Drugs, Nomenclature of Pharmaceuticals, Drug metabolism reactions, Structure, stereochemistry, nomenclature, mode of action, specific clinical applications and structure activity relationships of following classes of drugs and synthesis/commercial routes to specified drugs.

2. Antiamoebic and Antiprotozoal Drugs: (8 Hrs)
Metronidazole, Diloxanidefuroate, Bilamical hydrochloride, Hydroxystilbamidineisothionate, Pentamidinioethionate, Nifurtimox, Suramin sodium, Carbarsone, Glycobiarsol, Melarsoprol, Sodium stibogluconate, Dimercaprool, Diethyldiethylamine citrate, Centarsone, Acetarsone, Antimony potassium tartarate, Bismuth sodium thioglycollate, Sulphonamide, Stibiophen. Bismuth sodium thioglycollamate, Furazolidone.

Commercial synthetic routes to: Metronidazole, ronidazole, flunidazole, iodoquinol, nifurfimax, benzindazole, tryparsamide.

Section-B

3. Antibacterials: (12Hrs)

Commercial synthetic / semi-synthetic routes to : 6-aminopenicillanic acid, ampicillin, amoxycillin, production of penicillin, 7-aminocephalsporanic acid, cephalaxin, cefotizoxime, cefaclor, cephalothin, Tetracyclines: doxycycline, nalidixic acid, sulfadiazine, Norflaxacin, Ciproflaxacin, O-flaxacin, Amiflaxacin, Difloxacin, Chloramphenicol, Nitroflurantion, Sulfamethoxazole, Acetylsulfoxiazeo,
Section-C

4. Cardiovascular drugs: (5Hrs)
Vasodilators, Antihypertensive agents, Antihypercholesterolemic drugs, Antiarrhythmic, drugs, Sclerosing agents, Coagulants and anticoagulants, Cardiotonic compounds, Synthetic hypoglycemic agents. **Commercial Synthetic route to** : Papverine, oxprenolol, atenolol, Nafidipine, Quinidine, Clofibrate, captopril, Diltiazem, Verapamil, clonidine, prazosine, Enalarpil.

5. Diuretics: (6 Hrs)
Osmotic agents, Acidifying salts, Mercurials, Purines and related heterocycles, Sulfonamides, Benzothiadiazene and related compounds, Chlorothiazides and analogs, Sulfamoylbenzoic acid and analogs, Endocrine antagonists, miscellaneous diuretics. **Commercial Synthetic routes to** : Furosemide, Methalthiazidemethylchlothlazide: Chlorothiazide, Triameterene, Hydrochlothiazide, Amelorida, Chlorthalidone.

Section-D

6. Analgesics and Antitussives(3Hrs)
Morphine and related opioids, Narcotic antagonists, **Synthetic analgesics-Antitussives**: Opium alkaloid, Morphine analogs, Synthetic non-narcotic antitussives, mucolytic agents. **Commercial routes to** : Meperidine, Methadone, dextro-Propoxyphene, Pentazocine, dextromorphpaine, Papaverine.

7. Anthelmintics: (8Hrs)
Introduction, Tetrachloroethylene, Piperazines, Gentian violet, Pyrviniumpamoate, Thiabendazole, Mabendazole, bapheniumhydroxynaphthoate, Dichlophene, Niclosamide, Levamisole hydrochloride, Tetramisole, Niridazole, Biothional, Antimonypotassiumtartrate, Stibiophen, Sodium Stibiocaptate.

**Books Recommended:**
Credit 0-0-3

1. Determine the concentration of Na\(^+\), K\(^+\) and Ca\(^{2+}\) present in tap water using flame Photometer.
2. Standardization of an acid with a standard solution of base using pH-meter.
3. Determine the pk values of an amino acid by pH metry.
4. Titration of a strong acid vs strong base, weak acid vs strong base and weak acid vs weak base by conductometry.
5. Titration of mixture of strong and weak acids with a strong base by conductivity.
6. Determination of dissociation constant of acetic acid by conductometry.
7. Verify Lambert-Beer Law and determine the molar extinction co-efficient: copper sulphate pentahydrate / or potassium dichromate.
8. Determination of iron using 1-10 phenanthroline by spectrophotometry.
9. Determine the composition of a complex by job’s method and determine the stability constant of the complex by spectrophotometry.
10. Simultaneous determination of Cr\(^{2+}\) and Mn\(^{2+}\) spectrophotometry.
11. The determination of aspirin and Caffein in a proprietary Analgesic by spectrophotometry.
13. Titration of HCL with NaOH using potentiometer.
15. Determination of composition of unknown sample by Refractometry. Molar refraction is an additive property.
17. Partial molar volume studies.
18. Determination of CMC of a surface active agent.
19. Determination of atomic parachor values of C.H.O.
20. Estimation of glucose and Ascorbic acid.

Books recommended:

1. Findlay's Practical Physical Chemistry.
3. Laboratory Handbook for Oil & Fat Analysis by L.V. Cock and C. van Rede.
Credit 0-0-3

1. Preparation / multistep synthesis, purification and spectroscopic characterization of organic Pharmaceuticals and intermediate given below.

2. Extraction and analysis of the following natural products.
   a). Eugenol from cinnanan leaf oil or cloves.
   b). Piperine from black pepper.
   c). Cucumarin from turmeric.
   d). Pectins from orange peels.
   e). Carotene from carrots.
   f). Oleo-resin from ginger.
   g). Alkaloid from cinchona bark.
   h). Trimyristin and tetraclecanoic acid from nutmeg.

Books Recommended:
3. Practical Pharmacognosy: Khandewal, K.R. NiraliPrakashan, Pune
4. Phytochemical methods by J.B. Harborn
Chemical Engineering-II
CYL - 571

Credit 3-0-0
Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

1. Evaporation (7Hrs)
   Liquid characteristics, Types of Evaporators, Boiling Point rise due to material in Solutions, Duhring’s rule, Boiling Point Rise due to Hydrostatic head, Single and Multiple effect evaporators, Enthalpy balance for single-effect evaporators.

2. Crystallization (4 Hrs)
   Growth and Properties of Crystals, Saturation, Nucleation, Crystallization rate, Fractional Crystallization, vacuum crystallizers, Draft tube-Baffle crystallizers.

Section-B

3. Filtration (11Hrs)
   Introduction, Classification of Filters, Filter presses, Plate-and Frame presses, Leaf filters, Rotary continuous filters, Filter aids, Filtration theory, Kozeny-Carman equation, Limitations of the Kozeny equation, constant-pressure filtration, correction for filter cloth resistance, Constant-rate filtration, Rotary-drum filters, Principle of centrifugal filtration, Batch top-driven centrifuges, Batch underdriven centrifuges, Continuous centrifuges, Disc type centrifuges.

Section-C

4. Distillation (12 Hrs)
   Vapour Liquid Equilibrium, Partial Vaporisation and Partial Condensation, Dalton’s and Raoult’s Laws, relative Volatility. Methods of Distillation, Two-component mixture; The Fractionating Column, Calculation of number of Plates using the Lewis-Sorrel Method, Calculation of Number of Plates using the McCabe-Thiele method, The q-line concept, Plate Efficiency, Azeotropic Distillation, Extractive Distillation, Steam Distillation, Packed Columns; General description, Types of Packings.
5. Absorption of Gases (7 Hrs)
Mechanism of Absorption, rate of Absorption, Capacity of Packed Towers, Height of column based on condition in gas film, Height of column based on liquid film, The operating line and graphical integration of Height of columns, The transfer unit, Plate Towers for gas absorption, Number of plates by use of Absorption factor.

6. Leaching and Extraction (4hrs)
Factors influencing the rate of Extraction, Number of Stages for Counter-Current washing, Graphical Methods, Mixing of Liquid Systems, Calculation of the number of theoretical stages in extraction operation (Cocurrent contact with Partially Miscible Solvent Co-current Contact with Immiscible Solvents, Counter current contact with Partially Miscible Solvents), Bollman Extractor.

Books Recommended:
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-III)
(Credit Based Evaluation & Grading System)

Medicinal Chemistry-II
CYL – 572

Credit 3-0-0
Time: 3 Hours
Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Structure, stereochemistry, Mode of action, Structure activity relationships, specific clinical applications of following classes of pharmaceuticals with synthetic/commercial route to the indicated examples.

Section-A
1. CNS Active Drugs: CNS Depressants: Hypnotics and Sedatives: (12Hrs)
   CNS-stimulants & Psychoactive Drugs: Analeptics, Purines, Psychomotor stimulants, Sympathomimetics, Monamine oxidase inhibitors, Tricyclic antidepressants, Miscellaneous psychomotor stimulants. Hallucinogens (Psychodelics, Psychomimetics): Indolethylamines, R-phenylethylamines, Butyrophenones and other miscellaneous drugs.
   Commercial Synthetic routes to: Thioridazine, Haloperidol, Chloropromazine, Phenytoin, Phenobarital, Methaqualone, Oxazepam, Diazepam, Cholridazepoxide, Lorazepam, Alprazolam, Amitriptyline, Imipramine, Amphetamine, Protriptyline, Chloripramine, Iproniazide.

Section-B
2. Antiviral Agents: (11Hrs)
   Commercial synthetic routes to: Acyclovir, Ganciclovir, Zidovudine, Enviroxime, Lamivudine, Idoxuridine, Disoxaril.
3 Antineoplastic Agents: (10Hrs)
Alkylating agents (Nitrogen mustards, Aziridines, Sulfonic acid Esters, Epoxides, Nitrosoureas, Triazenes, Phosphamides, Mitomycin, Comparative activity of alkalyting agents).
Antimetabolites: Antifolates (Methotrexate), Mercaptopurine, Thioguanine, Flououracil, Floxuridine, Cytarabine, Azathioprine,
Commercial synthetic routes to: Methtrexate, Trimetrexate, Adatrexate, Dromostanolone, Cytarabine, Fludarabine, Dezaguanine, Bisanteneres.

4. Non-Steroidal Anti-inflammatory drugs (NSAIDS) (7Hrs)

5. Antimalarials: (5Hrs)
Cinchona alkaloids, 4-Aminoquinolines, 8-Aminoquinolines, 9-Aminoacridines, Biguanides, Pyramidines and Sulfones, Mefloquine, Sulfonamides.
Commercial synthetic routes to: Chloroquine, pamaquine, primaquine, proguanil, Amodiaquine, Mefloquine, Pyremethamine, Sontoquine.

Books Recommended:
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-III)  
(Credit Based Evaluation & Grading System)

Inorganic Chemistry-II  
CYL-573

Credit 3-0-0  
Time: 3 Hours  
Max. Marks: 100  
Mid Semester Marks : 20  
End Semester Marks : 80

Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

1. Theory of Chemical Bonding : (7Hrs)
   b) Molecular Orbital Theory : A brief introduction to ICAD method. Resonance integral, energy level diagrams for O_2, F_2, CO, CO_2, PH_3, BF_3, NO, NO_2, NO_3 and H_2O. Molecular orbital description of tetrahedral and octahedral complexes of transition metals.

2. Introduction to Ligands, Complexes and their Reactivity: (5 Hrs)
   Thermodynamics stability in aqueous medium, General classification of ligands, Ligand substitution or exchange reaction to 4-coordinate square planner complexes and 6-coordinate octahedral complexes. Redox or electron transfer reactions. Outer and inner sphere mechanisms for multielectron redox reaction and ligand field considerations. Photochemical reaction of chromium and ruthenium complexes. Fluoxional molecules iso- and heteropolyacids, metal clusters. Spin crossover in coordination compounds.

Section-B

3. Bioinorganic Chemistry : (11Hrs)
   Metal ions in Biology, Molecular mechanism of ion transport across membranes; ionophores. Photosynthesis, PSL, PSH; nitrogen fixation, oxygen uptake proteins, cytochromes and ferredoxins. Iron-sulphur proteins.

Section-C

4. Metals in Biology: (11 Hrs)
Section-D

5. Chemistry of Non-transition Elements: (6 Hrs)
Polymorphism of carbon, phosphorus and sulphur. Synthesis, properties and structure of boranes, carboranes, borazines, silicates carbides, silicones, phosphazenes, sulphur nitrogen compounds, phosphorus, sulphur and halogens, interhalogenspseudohalides.

6. Macrocyclic Ligands and Macrocyclic effects: (5Hrs)
Crown ethers and coronanads, Cryptands, Cation selectivity. Factors influencing selectivity such as nature of donor atoms, the number of & special arrangement of donor atoms cavity shape and size, conformational rigidity and flexibility of ligand lipophilicity and electronic influences.

Books Recommended:

M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-III)  
(Credit Based Evaluation & Grading System)  

Drug Design and Drug Development  

CYL – 574  

Credit 4-0-0  
Time: 3 Hours  
Max. Marks: 100  
Mid Semester Marks : 20  
End Semester Marks : 80  

Mid Semester Examination: 20% weightage  
End Semester Examination: 80% weightage  

Instructions for the Paper Setters:  
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four  
Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are  
required to attempt five questions, selecting at least one question from each Section. The fifth  
question may be attempted from any Section.  

Section-A  
1. **Introduction History and Objective of drug designing**:  
   Economic aspects of drug designing. Procedures followed in drug designing. Lead based  
   methods. Approaches to lead discovery. Drug discovery without a lead-de Novo drug designing.  
2. **Structure Activity Relationships**:  
   Quantitative analysis of structure activity relationships. Hansch Paradigm for pharmaceuticals -  
   Apparent lack of structure-activity relationships. Apparent structure activity relationships, True  
   structure activity relationships. **Extra-thermodynamic parameters**: Electronic, Steric and  
   Hydrophobic substituents constant. Hansch analysis, Free and Wilson method Physicochemical  
   coefficient and its significance.  

Section-B  
3. **Drug Designing and molecular orbital method**:  
   Molecular orbital calculations and chemical reactivity. Perturbation theories of drug action.  
   Pullman’s dipositive bond theory. Role of charge transfer processes in drug action.  
   Conformational aspects and molecular orbital calculations.  
4. **Pharmacokinetics in Drug designing-I**:  
   Pharmacokinetics, Environmental pharmacokinetics. Single and two compartment  
   pharmacokinetics. Pharmacokinetics of drug metabolism. Dissection of a drug molecule into  
   biofunctional moieties.  

Section-C  
5. **Pharmacokinetics in Drug designing-II**:  
   Modulation of pharmacokinetics by molecular manipulations: modulation of distribution of  
   pharmacea over various compartments, modulation of time-concentration relationship.  
6. **Drug Receptor - Interaction**:  
   Historical, Receptor theories and forces involved in drug receptor interaction. Stereochemical and  
   conformational aspects of drug receptor interaction. Agonists and Antagonists. Designing or  
   receptor antagonists. Receptor binding as a tool in designing biologically active steroids.
Section-D

7. Designs of Enzyme inhibitor:  (8Hrs)

8. Prodrug Approach:  (7 Hrs)

Books Recommended:

Photochemistry and Pericyclic Reactions

CYL-575

Credits: 3-0-0
Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

1. Photochemical Reactions 2Hrs
Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

2. Determination of Reaction Mechanism 3 Hrs.

3. Photochemistry of Alkenes 6 Hrs.
Intramolecular reactions of the olefinic bond- geometrical isomerism, cyclisation reactions, rearrangement of 1, 4-dienes,

Section-B

4. Photochemistry of Carbonyl Compounds 8Hrs
Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β,γ-unsaturated and α,β -unsaturated compounds, Cyclohexadienones.
Intermolecular cyloaddition reactions – dimerisations and oxetane formation.

5. Photochemistry of Aromatic Compounds 4 Hrs
Isomerisations, additions and substitutions.

Section-C

6. Pericyclic Reaction 12Hrs
Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5- hexatriene andallyl system. Classification of pericyclic reactions. Woodward ---Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions --- conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloaddition – antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions.
Section-D

7. Sigmatropic Rearrangements 5Hrs
Suprafacial and antarafacial shifts of H, sigmatropic shifts

8. Miscellaneous Photochemical Reactions 5Hrs
Photo-Fries reactions of anilides. Photo-Fries rearrangement.
Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog.

Books:
1. Fundamental of Photo Chemistry By K.K. Rohtagi Mukherji
2. Molecular Photochemistry By N.J. Turro and W.A. Benjamin
3. Introductory Photochemistry By A. Cox and T. Camp
4. Modern Organic Photochemistry By W. H. Horsepool
M.Sc. APPLIED CHEMISTRY (PHARMACEUTICALS) (SEMESTER-III)
(Credit Based Evaluation & Grading System)

Process Control and Plant Economics

CYL-576

Credit 3-0-0
Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A
1. Fundamental of Automatic Control: (11)
The general control system, open and closed loop systems, feedback control, forward feed control, Block diagram. Transfer functions by the use of Laplace transform, First order systems, Response of thermometric bulb, General response to step inputs, Response of liquid level systems, Response of mixing process, Linearization, Transportation Lag.

Section-B
2. Types of control systems: (6)
Control system, Block diagram, Negative and positive feedback, Development of block diagram, measuring element. Block diagram of a chemical reactor control system

Control valves, On-off control, proportional control, Integral derivative action, proportional integral control, proportional derivative control, proportional Integral derivative control.

Section-C
3. Applications of Control Systems: (7)
Overall transfer function for single loop system, for change in set point, for change in load and for multi loop control system. Control of a steam jacketed kettle, analysis of valve, block diagram, response of a gas absorber and heat exchanger.

Section-D


6. Optimization Methods: General procedure for determining optimum conditions, comparison of graphical and analytical methods, optimum flow rate of cooling water, optimum reflux ratio.

Books Recommended:

Green Chemistry and Waste Treatment

Section-A

1 Green Chemistry-(12Hrs)

Section-B

2. Application of Green Chemistry in organic Synthesis: (10Hrs)
Concept of atom-economy: Synthesis of ibuprofen, microbes in synthesis of adipic acid and catechol, Green reactions – Strecker reaction, halide free synthesis of aromatic amines, selective methylation using dimethylcarbonate.

Section-C

3. Water Pollution and Waste Treatment (12Hrs)

Section-D

4. Waste Water Treatment Plants (11Hrs)
Books Recommended:

Experiments

Unit-I

1. Preparation of tablets by dry / wet granulation method and their evaluation.
2. Coating of granules and tablets and their evaluation.
3. Microencapsulation and evaluation in microcapsules.
4. Preparation of sustained release tablets and capsules and their evaluation.
5. Filling sealing and evaluation of hard galatin capsules.
6. Preparation of Shampoo.
7. Preparation of simple syrup and evaluation.
8. (i) Preparation of iodine solution and evaluation.
   (ii) Preparation of strong iodine solution and evaluation.
11. Preparation of Boric acid glycerin/tannic acid glycerin/phenol glycerin.
12. Preparation of cough mixture.
13. Preparation of peppermint water / rose water.
14. Preparation of cresol with soap solution.
15. Preparation of non-staining iodine ointment cum methyl salicylate.
16. Formulation of suppositories.
17. Formulation of ointment(s).
18. Preparation of cold cream, vanishing cream, Tooth-Paste and after-shave lotion.
19. To carry out accelerated stability studies of tablets / capsules / syrups.
20. To find out base adsorption for a given drug.
21. Evaluation of packing materials (strip packs & Blisher Packs)
   i) Thickness of Aluminium foil and lamination.
   ii) Water permeability and quality of printing.

Unit-II

Experiments:

1. Estimation of glucose in blood.
2. Estimation of liver glycogen.
4. Determination of creatinine and creatin in blood and urine.
8. Determination of acid & alkaline phosphatase.
10. Determination of blood cholesterol.
11. Estimation of RNA and DNA.
13. Fat determination in milk.
List of Experiments

1. To analyse water quality of given water sample i.e. pH, electrical conductivity, total dissolved salts (TDS), alkalinity, and total hardness (Ca and Mg).
2. To determine dissolved oxygen content in given water sample using Winkler Method.
3. To determine copper content in given solution by iodometry/AAs/MPAES.
4. To determine formal redox potential of Fe^{2+} -Fe^{3+} redox system.
5. To determine the composition of a mixture of strong and weak acids (HCl + CH_3COOH) by conductometric titrations.
6. To determine acid and base dissociation constants of amino acid using pH measurements.
7. To determine the concentration of ions (Na^+ /K^+) in given solution by drawing calibration curve.
8. Determine the molar refractivity for water/DMSO/DMF/acetone/dioxane/CCl_4 /CH_3COOC_2H_5 and their mixtures and verify the additivity rule. Predict about the interaction between two compounds of mixture by plotting refractive indices vs. mole fraction.
9. To determine fluoride content by SPANS Spectrophotometric method.
10. Synthesis of ZnO nanoparticles using organic template and their characterization using XRD and UV techniques.
11. Determination of Strength of Sodium Carbonate in washing soda.
12. Determination of Strength of given oxidizing agent e.g. Hydrogen Peroxide.
13. Determination of Strength of given reducing agent e.g. Sodium dithionite.
14. Determination of Strength of given cationic surfactant
15. Determination of Strength of given anionic surfactant
16. Determination of cloud point of non-ionic surfactant

SEMESTER-IV

PROJECT WORK (INDUSTRIAL TRAINING)