Academic Regulations-M.Pharm. 2009-10

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**ACADEMIC REGULATIONS FOR THE AWARD OF FULL TIME**
**M. Pharm. DEGREE**
**(WITH EFFECT FROM THE ACADEMIC YEAR 2009-10)**

The Jawaharlal Nehru Technological University Anantapur shall confer M.Pharm. Post Graduate degree to candidates who are admitted to the Master of Pharmacy Programs and fulfill all the requirements for the award of the degree.

## 1.0 ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each programme, from time to time.

1.1. Admissions shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test conducted by the University or on the basis of GATE / PGECET score, subject to reservations prescribed by the University or Government policies from time to time.

## 2.0 COURSE WORK:

2.1 A Candidate after securing admission must pursue the M.Pharm. course of study for Four Semesters duration.
2.2 Each semester shall be of 20 weeks duration including all examinations.
2.3 A candidate admitted to a programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

## 3.0 ATTENDANCE

3.1 A candidate shall be deemed to have eligibility to write end semester examinations if he has put in at least 75% of attendance on cumulative basis of all subjects/courses in the semester.
3.2 Condonation of shortage of attendance up to 10% i.e., from 65% and above and less than 75% may be given by the college on the recommendation of the Principal.
3.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.
3.4 If the candidate does not satisfy the attendance requirement he is detained for want of attendance and shall reregister for that semester. He / she shall not be promoted to the next semester.

## 4.0. EVALUATION:

The performance of the candidate in each semester shall be evaluated subject wise, with a maximum of 100 marks for Theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

4.1 For the theory subjects 60% of the marks will be for the External End Examination. While 40% of the marks will be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately after the completion of instruction (V-VIII) units with Three questions to be answered out of four in 2 hours, evaluated for 40 marks.

*****Note: All the Questions shall have equal weightage of 10 marks and the marks obtained for 3 questions shall be extrapolated to 40 marks, any fraction rounded off to the next higher mark

4.2 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day to day performance.

4.3 For mini project there will be an internal evaluation of 50 marks. The candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting H.O.D. and two internal staff members/experts.

4.4 For Seminar there will be an internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts at the end of IV semester instruction.

4.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

4.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 4.5.) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

## 5.0 RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS:

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

5.1 The candidate should have completed the course work and obtained examinations results for I & II semesters.

5.2 He should have passed all the subjects for which the Internal evaluation marks secured are more than 50%.

5.3 Out of the subjects the candidate has failed in the examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of two Theory subjects for Improvement of Internal evaluation marks.

5.4 The candidate has to re-register for the chosen subjects and fulfill the academic requirements.

5.5 For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the Registrar,

JNTUA payable at Anantapur along with the requisition through the Principal of the respective college.

5.6 In the event of availing the Improvement of Internal evaluation marks, the internal marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

## 6.0 EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ institute.

6.1 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem)

6.2 An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor and one internal senior expert shall monitor the progress of the project work.

6.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest and one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained form the Head of the Institution.

6.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C. before submission of the Project Report.

6.5 A candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva-voce examination may be conducted once in two months for all the candidates submitted during that period.

6.6 Three copies of the Thesis / Dissertation certified in the prescribed from by the supervisor & HOD shall be presented to the University.

6.7 The college shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by one examiner nominated by the University.

6.8 If the report of the examiner is favorable viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the thesis / dissertation. The board shall jointly report candidates work as:

| | | |
|---|---|---|
| 1. | Very Good | Grade A |
| 2. | Good | Grade B |
| 3. | Satisfactory | Grade C |
| 4. | Not satisfactory | Grade D |

If the report of the viva-voce is not satisfactory (Grade D) the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit thesis.

## 7.0 AWARD OF DEGREE AND CLASS:

A candidate shall be eligible for the award of respective degree if he satisfies the minimum academic requirements in every subject and secures 'satisfactory' or higher grade report on his thesis/dissertation and viva-voce. Based on overall percentage of marks obtained, the following class is awarded.

| | |
|---|---|
| First class with Distinction: | 70% or more |
| First class | below 70% but not less than 60% |
| Second class | below 60% but not less than 50% |

## 8.0 WITH – HOLDING OF RESULTS:

If the candidate has dues not paid to the university or if any case of in- discipline or malpractice is pending against him, the result of the candidate shall be withheld and he will not be allowed/ promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

## 9.0 TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to 4.6 and 2.3 sections. Whereas they continue to be in the academic regulations they were first admitted.

## 10.0 GENERAL:

i. **The academic regulations should be read as a whole for purpose of any interpretation**.
ii. **Disciplinary action for Malpractice/improper conduct in examinations is appended.**
iii. **There shall be no place transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.**
iv. **Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".**
v. **In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.**
vi. **The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on roles with effect from the dates notified by the University.**

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# RULES FOR DISCIPLINARY ACTION FOR MALPRACTICE / IMPROPER CONDUCT IN EXAMINATIONS

| | Nature of Malpractices/Improper conduct | Punishment |
|---|---|---|
| | *If the candidate:* | |
| 1. (a) | Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. |
| (b) | Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him. |
| 2. | Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.<br>The Hall Ticket of the candidate is to be cancelled and sent to the University. |
| 3. | Comes in a drunken condition to the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. |

| | | |
|---|---|---|
| 4. | Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 5. | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 6. | Possess any lethal weapon or firearm in the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. |

| | | |
|---|---|---|
| 7. | Impersonates any other candidate in connection with the examination. | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him. |
| 8. | Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them. |

| | | |
|---|---|---|
| 9. | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.<br>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them. |
| 10. | Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | Cancellation of the performance in that subject. |
| 11. | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations. |
| 12. | If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment. | |

<u>Malpractices identified by squad or special invigilators</u>

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Impose a suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**Course Structure and Syllabi for**
**M. Pharm- Pharmaceutical Chemistry**
**for affiliated and constituent Pharmacy Colleges 2009-10**

**I YEAR I Semester**

| S. No | Course code | Subject | Theory | Lab. | Credits |
|---|---|---|---|---|---|
| 1. | 9S01101 | Modern Pharmaceutical Analysis | 4 | | 4 |
| 2. | 9S01102 | Bio-Statistics, Intellectual Property Rights & Regulatory Affairs | 4 | | 4 |
| 3. | 9S02103 | Advanced Pharmaceutical Organic Chemistry – I | 4 | | 4 |
| 4. | 9S02104 | Advanced Medicinal Chemistry – I | 4 | | 4 |
| 5. | 9S01105 | Modern Pharmaceutical Analysis Practical | | 6 | 4 |
| 6. | 9S02106 | Advanced Pharmaceutical Chemistry Practical- I | | 6 | 4 |
| 7. | 9S02107 | Mini-project- I | | 3 | 2 |
| | | contact periods/week | 16 | 15 | 26 |
| | | | Total 31 | | |

**I YEAR II SEMESTER**

| S. No | Course code | Subject | Theory | Lab. | Credits |
|---|---|---|---|---|---|
| 1. | 9S02201 | Drug Design | 4 | | 4 |
| 2. | 9S02202 | Advanced Pharmaceutical Organic Chemistry – II | 4 | | 4 |
| 3. | 9S02203 | Advanced Medicinal Chemistry – II | 4 | | 4 |
| 4. | 9S02204 | Advanced Chemistry of Natural Products | 4 | | 4 |
| 5. | 9S02205 | Advanced Medicinal Chemistry Practical | | 6 | 4 |
| 6. | 9S02206 | Advanced Natural Products Chemistry Practical | | 6 | 4 |
| 7. | 9S02207 | Mini-project- II | | 3 | 2 |
| | | contact periods/week | 16 | 15 | 26 |
| | | | Total 31 | | |

**II YEAR (III & IV Semesters)**

| S. No | Course code | Subject | | credits |
|---|---|---|---|---|
| 1 | 9S02401 | Seminar | | 2 |
| 2 | 9S02402 | Project work | | 16 |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**M.Pharm I year I semester Pharmaceutical Chemistry** **Th 4** **C 4**

**(9S01101) MODERN PHARMACEUTICAL ANALYSIS**

1. **UV-VISIBLE SPECTROSCOPY**: Brief review of electromagnetic spectrum, UV-Visual range, energy, wavelength and color relationships. Interaction of electromagnetic radiation (UV-visible) with matter and its effects. Chromophores and their interactions with E.M.R. Absorption spectra of organic compounds and complexes illustrating the phenomenon and its utilization in qualitative and quantitative studies of drugs. Shifts and their interpretation (including solvent effects). Empirical correlation of structure with absorption phenomena (Woodward's rules etc) Quantitative estimations, Modern instrumentation.

2. **a) INFRARED SPECTROSCOPY**: Nature of Infra-red radiation. Interaction of I.R radiation with I.R molecules and effects on bonds. Molecular Infrared Spectra. Brief outline of classical I.R instrumentation and practical details of obtaining spectra, including sample preparation for spectroscopy, quantitative interpretation of I.R spectroscopy including FT-IR, ATR.

   **b) OPTICAL ROTATORY DISPERSION:** Fundamental principles of ORD, cotton effect curves, their characteristics and interpretation. Octant rule and its application with examples. Circular dichroism and its relation to ORD.

3. **NMR SPECTROSCOPY:** Fundamental principles of NMR (Magnetic properties of nuclei, applied field and precession; absorption and transition; frequency). Chemical shifts concept: Isotopic nuclei, Reference standards: Proton magnetic spectra, their characteristics, presentation terms used in describing spectra and their interpretation (Signal No., Position, Intensity). Brief outline of instrumental arrangements and some practical details. Signal multiplicity phenomenon in high resolution PMR. Spin-spin coupling. Application of Signal split and coupling constant data to interpretation of spectra. De-coupling and shift reagent methods. Brief outline of principles of FT-NMR with reference to 13CNMR. Spin-spin and spin-lattice relaxation phenomenon. Free induction decay (FID) proton noise de-coupling signal, average time domain and frequency domain signals nuclear overhauser enhancement 13CNMR spectra, their presentation; characteristics, interpretation, examples and applications. Brief indication of application of magnetic resonance spectral data of other nuclei by modern NMR instruments. Introduction to 2-D NMR techniques.

4. **MASS SPECTROSCOPY:** Basic principles and brief outline of instrumentation. Ion formation and types; molecular ion, Meta stable ions, fragmentation processes. Fragmentation patterns and fragmentation characteristics in relation to parent structure and functional groups. Relative abundances of isotopes and their contribution to characteristic peaks. Mass spectrum, its characteristics, presentation and interpretation. Chemical ionization Mass Spectroscopy. GC-MS, other recent advances in MS. Fast atom bombardment mass spectrometry. LC-MS, LC MS-MS.

5. **CHROMATOGRAPHIC TECHNIQUES:** Classification of chromatographic methods based on mechanism of separation. Column chromatography, column materials, merits and demerits. Paper chromatography; techniques and applications. Thin Layer Chromatography, comparison to paper chromatography and HPLC, adsorbents for TLC. Preparation techniques, mobile phase selection, reversed phase TLC, High performance TLC detection methods, quantitative methods in TLC. Programmed multiple development techniques.

6. **GAS CHROMATOGRAPHY:** Instrumentation packed and open tubular column, Column efficiency parameters, the Vandeemeter equation, Resolution, liquid stationary phase, derivatization methods of GC including acylation, perfloro acylation, alkylation and esterification. Detectors: FID, ECD, TCD, NPDA. Critical comparison of sensitivity, selectivity and field of applications of these detectors. Examples of GC applications in pharmaceutical analysis.

7. **LIQUID CHROMATOGRAPHY:** Comparison of GC and HPLC, instrumentation in HPLC, analytical, preparative and microbore columns, normal and reversed phase packing materials, reverse phase HPLC, Column selection, Mobile phase selection, Efficiency parameters, resolution, detectors in HPLC refractive index, photometric and electrochemical. Comparison of sensitivity, selectivity and field of applications of these detectors. HPTLC-instrumentation and applications.

8. **ELECTROPHORESIS:** Moving boundary electrophoresis, Zone electrophoresis, Iontophoresis, PAGE, Isotacophoresis and applications in pharmacy.
   **X-ray Diffraction methods:** introduction, generation of X-rays, elementary crystallography, Miller Indices, X-rays diffraction, Bragg's law, X-ray powder diffraction, X-ray powder diffractometer, obtaining and interpretation of X-ray powder diffraction data. Principle, instrumentation and application of the following: Differential Scanning Colorimetry (DSC), DTA &TGA in analysis of pharmaceuticals.

**REFERENCES:**


1. Instrumental methods of chemical analysis by chatwal. K, anand, 5th edition.
2. Vogel's text book of quantitative chemical analysis by G.H.Jeffery, J.Bassett, J.Mendhan, R.C.Denny.
3. Instrumental methods of analysis by Willard, Merit, Dean, Settle.
4. Organic spectroscopy by Y.R.Sharma.
5. Spectrometric identification of organic compounds by silverstein, Webster.
6. Spectroscopy by B.K.Sharma
7. Fundamentals of analytical chemistry by Skoog
8. Instrumental methods of analysis by Skoog.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**M.Pharm I year I semester Pharmaceutical Chemistry** **Th 4** **C 4**

## (9S01102) BIO-STATISTICS, INTELLECTUAL PROPERTY RIGHTS & REGULATORY AFFAIRS

### I. BIO-STATISTICS

1. **An introduction** to statistics and biostatistics-collection and organization of data, graphical, pictorial presentation of data, measures of central tendency and dispersion, sampling techniques, sample size, Coefficient of variation, mean error, relative error, precision and accuracy
2. **Tests of significance**: Testing hypotheses – Principles and applications of Z, t, F–ratio and chi-square tests in pharmaceutical and medical research. Non-parametric tests: sign test, Wilcoxon signed rank test, Wilcoxon rank sum test, Kruskal Wallis test, run test and median
3. **Design of Experiments**: Principles of randomization, replication and local control; CRD, RBD, LSD – their applications and analysis of data; Factorial Experiments – Principles and applications; Probit analysis: Dose – effect relationships, calculation of $LD_{50}$, $ED_{50}$.

**Statistical quality control** : Meaning and uses , Construction of $\overline{X}$, R, P, ηp and Ć chart-s.

### II. INTELLECTUAL PROPERTY RIGHTS & REGULATORY AFFAIRS

1. Patents and Intellectual Property Rights (IPR): Definition, scope, objectives, sources of patent information, patent processing and application. Patents, Copyrights, Trademarks, Salient features, international and regional agreements.
2. GATT & WTO: GATT – Historical perspective, objectives, fundamental principles, impact on developing countries. WTO – objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India – task and challenges, trade related aspects (TRIPS).
3. Regulatory Affairs : Indian context – requirements and guidelines of GMP, understanding of Drugs and Cosmetics Act 1940 and Rules 1945 with reference to Schedule N ,U & Y.
4. **a)** Related Quality Systems: Objectives and guidelines of USFDA, WHO and ICH. Introduction to ISO series.
   **b)** Documentation: Types related to pharmaceutical industry, protocols, harmonizing formulations, development for global filings, ANDA, NDA, CTD, dealing with post – approval changes – SUPAC, handling and maintenance including electronic documentation.

**REFERENCES:**


1. 'Biostatistics', KS Negi, AITB Publishers, Delhi.
2. 'Fundamentals of Biostatistics',Irfan Alikhan, Ukaaz Publications
3. 'Biostatistics for Pharmacy', Khan and Khanum, Ukaaz Publications
4. 'Basic statistics and Pharmaceutical applications', J.E, Demuth,Mercel & Dekker.
5. 'Applied statistics' by S.C.Gupta & V.K.Kapoor
6. 'Fundamentals of mathematical statistics' by S.C.Gupta & V.K.Kapoor
7. 'Good Manufacturing Practices for Pharmaceuticals', S.H.Wiling, Vol.78, Marcel Decker.
8. 'Protection of Industrial Property rights', P. Das & Gokul Das
9. 'Law and Drugs', S.N. Katju, Law Publications.
10. 'Original Laws' Published By Govt. of India
11. 'Laws of drugs in India', Hussain
12. 'New Drug Approval Process', R.A.Guarino,Vol 100, Marcel Decker, NY
13. fda.org, wipo.int, patentlawlinks.com, hc-sc.gc.ca, ich.org, cder.org


**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**M.Pharm I year I semester Pharmaceutical Chemistry** **Th 4** **C 4**

**(9S02103) ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY – I**

1. Stereochemistry: Elements of symmetry, plane of symmetry, centre of symmetry, alternative axis of symmetry, simple axis of symmetry, kinds of molecules displaying optical activity. Notation, relative configuration and absolute configuration. Configurational nomenclature: D, L and R, S–nomenclature. Compounds with a chiral carbon atom, compounds with other quadrivalent chiral atoms. Optical isomerism in compounds containing no chiral atom, biphenyl, allenes, compounds with exocyclic double bonds and spirans. Chirality due to helical shape, chirality caused due to restricted rotation (other types).
2. Cis / Trans, E – Z isomerism resulting from double bonds, monocyclic compounds, fused ring system. Racemic modifications and methods for resolution of racemic mixtures. Asymmetric synthesis and stereo–selective synthesis.
3. Reactive Intermediates: Definitions, generation, stability, structure and reactivity of free Radicals: carbocations, carbanions, carbenes, Nitrenes / Nitrenium ions.
4. Mechanisms of organic reactions:
   a) Substitution: Aromatic and Aliphatic nucleophilic substitution reactions ($SN^1$ & $SN^2$), Aromatic and Aliphatic electrophilic substitution reactions, free radical substitution reactions
   b) Addition Reactions: Electrophilic, nucleophilic and free radical addition reactions. Addition to carbon- carbon multiple bonds, Carbon- hetero multiple bonds.

5. Elimination Reactions: $E_1$, $E_1CB$ and $E_2$ mechanisms and orientation in Pyrolytic eliminations, effect of substrate structure, Attacking base, leaving group and reaction bond, medium and reactivity addition to carbon – carbon multiple bond reactions: mechanisms, Orientation and reactivity.
6. Electrocyclic, pericyclic and sigmotropic reactions: introduction, terminology and mechanism with suitable examples.
7. Concepts of aromaticity involving ring systems and anti aromaticity.
   Aromatic Substitution reactions, Electrophilic aromatic substitution.
   Mechanisms, Orientation and reactivity.
8. Molecular Rearrangements & their applications:
   - Carbon to Carbon Migration: Wagner – Meerwin rearrangement, Claisen rearrangement and benzil – benzilic acid rearrangement.
   - Carbon to Nitrogen Migration: Hoffmann rearrangement, Curtius rearrangement and Lossen rearrangement, Beckman rearrangement.
   - Carbon to Oxygen Migration: Bayer – Villiger rearrangement, Rearrangement of hydro peroxides and Wittig rearrangement.

**REFERENCES**

1. 'Advanced Org. Chemistry', Francis A. Carey & Richard J. Sunberg, 3rd Edition , Part B; Reactions and synthesis , Plenum Press, new York , London , Latest Edition.
2. 'Stereochemistry of Org. Compounds', Eliel I. Ernest and Samuel h, John Wiley and sons, New York, 2003 Edition.
3. 'Orbital Symmetry: A Problem solving approach', Roland E. Lehr & Alan P Marchard, Latest Edition, Academic Press, New York
4. 'Advanced Org. Chemistry, Reactions Mechanisms and Structure', J. March , 4th Edition, Latest Edition, John Wiley & Sons , New York.
5. 'Organic Chemistry', I. L. Finar , ELBS
6. 'Modern Synthesis Reactions', Herbert O. IInd Edition W.A. Beenamis Inc. Menco Park California.
7. 'Some Modern Methods of Org. Synthesis', W. Carruthers, 3rd Edition, Cambridge University Press, Cambridge.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**M.Pharm I year I semester Pharmaceutical Chemistry** **Th 4** **C 4**

**(9S02104) ADVANCED MEDICINAL CHEMISTRY – I**

1. Theoretical Aspects of Drug Action
   Types of drug action, Physiochemical parameters and pharmacological activity. Non empirical Electronic parameters, stearic parameters and Stereo Chemical aspects of Drugs. Drug Receptors, Receptor types and isolation, Drug Receptor Interaction, theories of drug action, mechanism of drug action.

2. Drugs acting on histamine receptors: Bio-synthesis and inactivation of histamine receptors and their classification into $H_1$, $H_2$ and $H_3$ sub types.
   a. $H_1$ receptor agonists: Synthesis of histamine
   b. $H_1$ receptor antagonists: Synthesis of chloropheniramine
   c. $H_2$ receptor agonists: Structure of impromidine
   d. $H_2$ receptor antagonists: Synthesis of ranitidine, cimetidine and famotidine
   e. Amino acid receptors: Introduction, classification into inhibitory and excitatory amino acid receptors. Biosynthesis and inactivation of GABA, Glutamic acid and Aspartic acid
   f. GABA Agonists: Synthesis of Baclofen. Structures of muscimol, thiomuscimol and dihydromuscimol
   g. GABA Antagonists: Synthesis of 5-Guanidine pentanoic acid and 5-Amino pentanoic acid.

3. Drugs acting on ion channels: Introduction to structure of cell membranes and ion channels.
   a. Drugs acting on $Ca^{++}$ channels: Synthesis and mode of action of Nefidepine and diltiazem
   b. Drugs acting on $Na^{+}$: Synthesis of tetracaine, amethocaine, etidocaine and lidocaine.
   c. Drugs acting on $K^{+}$ channels: Synthesis of 4-Amino pyridine.

4. Neurotransmitters and their receptors:
   a. Adrenergic receptors: Biosynthesis and inactivation of adrenergic neurotransmitters. Adrenergic receptors their classification into α and β sub types.
   b. Drugs affecting adrenergic neuro transmission: Drugs acting on biosynthesis of adrenergic neurotransmitters(Metyrosin), Drugs effecting catecholamine storage and release(Reserpine)
   c. α- Adrenergic receptor agonists: Synthesis of Norepinephrine, Epinephrine and methyl dopa.
   d. α- Adrenergic receptor antagonists: Structural formulae of APC and Benextramine. Synthesis of phenoxy benzamine, Terazosin and prazosin

e. β - Adrenergic receptor agonists: Synthesis of Dobutamine, Salbutamol
f. β - Adrenergic receptor antagonists: synthesis of propranalol and atenolol

5. Cholinergic receptors: Biosynthesis and inactivation of Acetyl choline.Cholinergic receptors and their classification into muscarinic and nicotinic receptors.
   a. Chlinergic agonists: Synthesis of acetyl choline, carbachol and bethanecol
   b. Cholinesterase inhibitors: Synthesis of Physostigmine and structure neostigmine
   c. Cholinergic antagonists: Muscarinic antagonists – Atropine (Only structure), Ganglionic antagonist- Nicotine, neuromuscular antagonists-Tubercurarine (Only structure) and synthesis of succinylcholine

   Dopamine receptors: Biosynthesis and inactivation of dopamine receptors
   a. Dopamine agonists: Synthesis of L-Dopa, fenoldapam
   b. Dopamine antagonists: Synthesis of chlorpromaizine
   c. Serotonin agonists: Synthesis of serotonin
   d. Serotonin antagonists: Synthesis of metaclopramide.

6. Targets for the development of following chemotherapeutic agents:
   Anti-tubercular, Anti-HIV, anticancer, anti–fungal, Immuno-modulators, anti-amoebic drugs.

7. Targets for the development of following pharmacodynamic agents –
   Antiulcer, Analgesic, Anti Inflammatory, Anti atherosclerotic, Anti- angiogenesis, Anti – hypertensives.

8. Biotransformation of drugs- Prodrug approach, Soft Drug approach, enzymes responsible for biotransformation, microsomal and non microsomal mechanisms. Factors influencing enzyme induction and inhibition.

**REFERENCES**

1. 'Org. Chemistry of Drug Design and drug Action', Richard B. Silvermann,.
2. 'Berger's Medicinal Chemistry and Drug Design', 6th Edition.
3. 'Essentials of Medicinal Chemistry', Korolkovas,
4. 'Strategies of Drug Design', Purcell,
5. 'Biochemical Basis of Drug Design', Alfred Berger,
6. 'Comprehensive Medicinal Chemistry', Corwin , Hansen,
7. 'Medicinal Chemistry', William O Foye,
8. 'Drug Metabolism Chemical & Biochemical Aspects', Testa B and Jenner P. , Marcel Dekker
9. 'Molecular Pathomechanism and New Trends in Drug Research', Gyorgy Keri & Istdan Toth, Taylor & Francis Pub.
10. 'Drug design medicinal chemistry a series of monograph Ariens', - volume 11- III, academic press, an imprint of Elsevier pub.

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| **M.Pharm I year I semester Pharmaceutical Chemistry** | **L** | **C** |
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## (9S01105) MODERN PHARMACEUTICAL ANALYSIS - PRACTICAL

1. Simultaneous estimation of Paracetamol and Ibuprofen, Rifampicin and INH, Aspirin and Caffeine.
2. UV-Visible spectrum scanning of certain organic compounds- absorption and co-relation of structures, comparisons.
   Ex: a. Chloramphenicol b. Sulphadiazine c. Analgin
3. Effect of pH and solvent on UV spectrum of certain drugs.
4. Two dimensional paper chromatography and TLC.
5. Gradient elution and other techniques in column chromatography.
6. Separation by electrophoresis.(PAGE and agarose Gel electrophoresis)
7. Experiments based on HPLC and GC.
8. IR, NMR and Mass spectroscopy of compound each.
9. DSC/XRD curves of a sample and mixture to understand polymorphism.
10. Determination of insulin / any other hormones by ELISA method.

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**(9S02106) ADVANCED PHARMACEUTICAL CHEMISTRY - I PRACTICAL**

1. Preparation of Benzanilide from benzophenone (Beckmann rearrangement) (Benzophenone----Benzophenoneoxime----Benzanilide)
2. Preparation of 2-phenol indole from acetophenone (Fishcher indolization). (Acetophenone---- Acetophenone phenyl hydrazine---- 2-phenyl indole)
3 Preparation of anti-pyrine from ethyl acetoacetate.(ethylacetoacetate----3-methyl-1-phenyl pyrazole-5-one----2,3-dimethyl-1-phenyl pyrazole-5-one)
4 Preparation of dibromocynamic acid from benzaldehyde (Perkins reaction) (Benzaldehyde----cinnamic acid----dibromocynamic acid)
5 Preparation of 2,5-dihydroxy acetophenone from hydroquinone (Fries rearrangement) (Hydroquinone---- Hydroquinone diacetate----2,5-dihydroxyacetoquinone).
6 Preparation of diethyl fumarate from mallic acid(racemisation) Mallic acid----fumaric acid----diethyl fumarate)
7 Preparation of 2,2-dihydroxy-1,1-biphenyl naphthal from 2-naphthal (oxidation and free radical coupling)
8 Preparation of Benzilic acid from Benzil (Benzilic acid rearrangement).
9 Qualitative analysis:
A minimum of 8 organic binary mixtures and 4 tertiary mixtures should be analyzed systematically by either separation technique or with the preparation of at least one derivative in each compound.

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**(9S02107) Mini-project- I**

The mini projects can be taken up as industrial visit/training and report submission.

Or

A suitable project shall be carried out in the college.

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**M.Pharm I year II semester Pharmaceutical Chemistry** **Th 4** **C 4**

**(9S02201) DRUG DESIGN**

1. Drug Discovery: introduction to drug discovery, without lead- serendipity-penicillin and Librium as examples. Lead discovery- random and non-random screening of natural products-medical folklore; synthetic banks. Existing drugs from natural ligand and modulator. Combinatorial synthesis, computer aided designing (introductory treatment only).
2. Principles of Drug Design: Structure pruning techniques in drug design, development of bioprecursors, prodrugs and softdrugs.
3. STAR Studies: Introduction to structure – Activity relationship (SAR) studies – (i) Binding role of hydroxyl group, amino group, aromatic ring, double bond, ketones and amides. (ii) Variation of substituents – Alkyl substituents, aromatic substituents, extention of structure, chain extension / contraction, ring expansion / contraction, ring variation, ring fussion. Isosteres. (iii) Simplification of structure, rigidification, conformational blockers, X-ray crystallographic studies.
4. Rational Drug Design: QSAR; parameters involved in QSAR, lipophilicity (polarisability, electronic and stearic parameters). Quantitative models – Hansch analysis, free Wilson analysis and their relationships, linear relationships and applications of Hansch and free Wilson analysis.
5. Molecular Modeling Drug Design: Molecular mechanism, quantum mechanism of known receptor sites: Definition, characterization of sites, design of ligands, visually assisted three dimensional data bases and calculation of drug affinity. Molecular mechanism, quantum mechanism of unknown receptor sites.
6. Design of Local Anesthetics:
   Introduction, general considerations on the development of new drugs, classical and rational procedures for the development of local anesthetics
7. Pharmacokinetic Oriented Drug Design:
   a. Drug Solubility: Solubility, varying polarity, varying Pka.
   b. Drug Stability: Stability, metabolic blocking, replacing metabolically susceptible groups, steric shields, electronic effects, stereochemistry, synergistic drugs, decreasing drug stability.
8. Preclinical Testing and Clinical Trails: Toxicology, Pharmacology and pharmaceutical chemistry, drug metabolism studies, clinical trails, regulatory affairs.

**REFERENCES**


1. 'Burgers Medicinal Chemistry and Drugs Design' 6th edition by Manfred E. Wolf.
2. 'Introduction to Medicinal Chemistry' by G. Patrick.
3. 'Introduction to Drug Design' by Silverman.
4. 'Principles of Medicinal Chemistry' Vol-I and II by Kadam etal.
5. 'Principles of Medicinal Chemistry' by William Foye.
6. 'Medicinal Chemistry' by Ashtoshkar.
7. fda.org, wipo.int, patentlawlinks.com, hc-sc.gc.ca, ich.org, cder.org

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## (9S02202) ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY – II

1. Synthetic Reagents & Applications: Lead Tetra Acetate (LTA), N- Bromosuccinimide (NBS), Osmium Tetroxide, Lithium Aluminum Hydroxide and Sodium Bromohydride.
2. Unit Process in Organic Synthesis: Catalytic hydrogenation, Nitration, Sulphonation, Halogenation, Amination, Acetylation, Esterification and Hydrolysis.
3. Scale Up Techniques for process optimization, Maximization of productivity, in – process control techniques with examples. Chemical Technology of selected bulk drugs – Ibuprofen, Paracetamol, Ciprofloxacin and Isosorbide Nitrate.
4. Synthetic Strategies-I : Introduction, target selection , disconnection approach; functional group inter conversions; synthons; reagents; retro synthesis; region selectivity; linear and convergent synthesis.
5. Synthetic Strategies-II : One group disconnections; two group disconnections; Strategic bonds; criteria for disconnection of strategic bonds in carbocyclic and heterocyclic rings; biomimetic approach; retro mass spectral fragmentation-case studies of (+) –Disparlure, retronecine and longifoline.
6. Combinatorial Chemistry – Parallel Synthesis (Houghton's teabag procedure, automated parallal synthesis), real combinatorial chemistry and deconvolution methods.
7. Modern Synthetic methods-I:
   Green synthesis: Introduction; green reagents; green catalysts; ionic solvents; phase transfer catalysis in green synthesis; application of phase transfer catalysts in green synthesis of heterocyclic compounds: Williamsons synthesis, Wittig reaction.
8. Modern Synthetic methods-I:
   Microwave assisted synthesis: Introduction; Microwave reactions in water (Hoffman elimination, hydrolysis and oxidation); microwave reaction in organic solvents; Solid state reactions; advantages of microwave technique.

**REFERENCES**


1. 'Some Modern Methods of Org. Synthesis', W. Caruthers , III rd Edition, Cambridge University Press, Cambridge(1988)
2. 'Unit process in Org. Synthesis', Groggin's, McGraw Hill Book Crop.
3. 'Org. Synthesis. The Disconnection Approach', S. Warren, J. Wiley & Sons. NY
4. 'Molecular Patho-mechanisms and New Trends in Drug Research', Gorgy Keri and Istarian Toth, – Taylor and Francis Group ,London 2003
5. 'New trends in Green Chemistry' - VK Ahluwalia & M Kidwai
6. 'A Guidebook to Organic Thesis', R.K. Mackie , – Prentice Hall
7. T.W. Greene and PGM Warts ,Protecting Groups – John Willey
8. Michael B. Smith , Organic Synthesis

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**M.Pharm I year II semester Pharmaceutical Chemistry** **Th 4** **C 4**

**(9S02203)ADVANCED MEDICINAL CHEMISTRY – II**

1. Enzyme Inhibitors: A detailed study of the following types of enzyme inhibitors ,related drugs and their pharmaceutical significance :
    a. P.G. Synthetase (Cycloxygenase & Lipoxygenase Inhibitors)
    b. Phosphodiesterase (PDE ) Inhibitors
    c. Carbonic Anhydrase Inhibitors.
    d. Angiotensin Converting Enzyme (ACE) Inhibitors
    e. Acetyl Cholinesterase (Ach E) Inhibitors.

2. Antipsychotic Agents: Roll of Dopamine, Serotonin, Glutamate and their receptors. SAR and Pharmacokinetics of Ticyclic Neuroleptics, Butyrophenones and Benzamides. A brief account of non – benzodiazepine agonist.

3. Psychopharmacological agents: Biochemical basis of mental disorders; abnormal protein factors; endogenous amines and related substances. Faulty energy metabolism; genetic disorders and nutritional disorders. Phenothiazines-chemistry: synthesis, screening methods; pharmacological actions; SAR, mechanism of action, uses; toxicity. Ring analogues of phenothiazines, fluorobutyrophenones; synthesis of chlorpromazine, prochlorperazine, fluphenazine, haloperidol.

4. Anxiolytics, Sedatives and Hypnotics: Benzodiazepines and related compounds; Barbiturates, other classes, mechanism of action, SAR, uses and toxicity, synthesis of chlordiazepoxide, diazepam, alprazolam, Phenobarbital, meprobamate.

5. Antidepressants: MAO Inhibitors; tricyclic antidepressants, SAR, mechanism of acton, uses, toxicity, other classes like: Selective serotonin reuptake inhibitors, selective norepinephrine reuptake inhibitors, newer (non-tricyclic) non selective 5-HT and NE reuptake inhibitors; selective serotoninergic reuptake inhibitors and 5-$HT_{2A}$ antagonists; 5-$HT_{1A}$ agonists and partial agonists and $\alpha_2$-antagonists. Synthesis of tranylcypromine, amitriptyline, fluxetine, buspirone.

6. Antiepileptics and CNS stimulants
    a. Antiepileptics: Screening methods, classification of epilepsy, symptoms, drugs used, classification, structural features common to drugs, SAR, mechanism of action, toxicity and uses, synthesis of diphenylhydantoin, carbamazepine, sodium valporate.
    b. CNS stimulants: An account of the drugs with CNS stimulant activity, structures and uses.

7. Diuretics: Anatomy and physiology of nephron, classification of diuretics based on site of action, carbonic anhydrase inhibitors, thiazide and thiazide-like diuretics, loop and potassium sparing diuretics, miscellaneous diuretics, emerging developments in the use of diuretics to treat hypertension and congestive heart failure.
8. A study of
    a. Antihyperlipidemic agents
    b. Phosphodiesterase inhibitors
    c. Quinolone antibacterial agents.

**REFERENCES**


1. Wilson and Gisvold's text book of pharmaceutical organic medicinal chemistry.
2. Gorgy Keri & Istdan Toth Molecular Pathomechanism and New Trends in Drug Research, Taylor & Francis Pub
3. Thomas Nogrady, Medicinal Chemistry. A biochemical Approach, Oxford Univ. Press.
4. Organic chemistry of synthetic drugs- Lednicer.
5. Berger's medicinal chemistry and drug design 6th edition.
6. Richard. B. Silverman, Organic chemistry of drug design and drug action.
7. Smith and Williams, Introduction to principles of drug design, Harwood Academy press.

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**M.Pharm I year II semester Pharmaceutical Chemistry** **Th 4** **C 4**

**(9S02204) ADVANCED CHEMISTRY OF NATURAL PRODUCTS**

1. (A) General Methods of Extraction, Qualitative chemical test for the detection of various Natural product compounds.
   (B) Study of herbal extracts – processing, equipment and analytical profile of extracts of Drugs.
2. Isolation/Separation techniques – The technique and application of thin layer chromatography and preparative TLC, column chromatography – medium and high-pressure liquid column chromatography, flash chromatography, HPTLC, HPLC and GC – normal and reverse phase techniques.
3. Alkaloids - Introduction, general methods of structure elucidation, chemistry and structure elucidation of morphine, reserpine and quinine. Isolation procedure of piperine and quinine.
4. Steroids – Introduction, nomenclature and stereochemistry, chemistry of cardiac glycosides, progesterone, oestradiol, cortisone, testosterone, bile acids, chemistry and structure elucidation of cholesterol, testosterone, progesterone. Synthesis of stilbesterol & hexesterol Isolation procedure of diosgenin and sennosides.
5. Polypeptides and Proteins – Introduction and general methods of separation, general methods of degradation and end group analysis, general methods of synthesis of peptides, Sequence analysis, secondary and tertiary structure of proteins, chemistry of insulin.
6. Natural Products as Leads for New Drugs
   Introduction/History, approaches to discovery and development of natural products as potential new drugs, selection and optimization of lead compounds for further developments from CNS, anti cancer, antibiotic and cardiovascular drugs.
7. Anticancer agents of natural origin
   a. Alkaloids of Vinca rosea: Vincristine and vinblastine- structures and SAR, semi synthetic derivatives, mechanism of action, uses and toxicity.
   b. Source and structures of Podophyllotoxin, taxol and camptothecin, semi synthetic derivatives, mechanism of action, uses and toxicity.
   c. Anticancer antibiotics: Source, structures, description of the structural features, mechanism of action, SAR and uses of the following antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, their daunomycinol, adriamycinol, their semi-synthetic derivatives, 4-deoxy and 4-epidoxorubicins, noglamycin and menogaril, mithramycin, mitomicin, streptozocin.
   d. Anticancer agents from marine organisms-Bryostatin, dolastatin etc.
8. Steroidal hormonal drugs:
   a. Steroidal antifertility agents: Estrogens, pregnane progestins, development of 19-norandrostanes, structures, mechanism of actions, regimen, toxicity.
   b. Anabolic steroids: Rationale for development, structures, uses, and limitations

c. Steroids in the treatment of cancers: Estrogens, Antiestrogens, Aromatase inhibitors, progestins, progestin antagonists, androgens and anabolic steroids, antiandrogens, 5α- reductase inhibitors, gonadotropin inhibitors, glucocorticoids.

**REFERENCES**


1. Organic Chemistry Vol. 2nd by I. L. Finar
2. Org. Chemistry by Morrison & Boyd
3. Alkaloids – Chemical & Biological Prospective by S. W. Pelletier
4. Steroids by Fischer and Fischer
5. Pharmacognosy by Trease & Evans
6. Chemistry of Natural Products – Ata Ur Rehman
7. Natural Products – A Lab Guide by Raphael Ikon
8. Wilson and Gisvold's text book of pharmaceutical organic medicinal chemistry.


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| **M.Pharm I year II semester Pharmaceutical Chemistry** | **L** | **C** |
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**(9S02205) ADVANCED MEDICINAL CHEMISTRY - PRACTICAL**

1. Synthesis, purification and identification of the following compounds employing micro TLC and Quantitative analysis:
   a. INH
   b. Methaqualone
   c. Chloramine T and Dichloramine T
   d. Saccharin Sodium
   e. 7-Nitrohydroxy-4-methyl coumarin
   f. Dapsone
   g. Phenytoin from Benzaldehyde
   h. Benzaldehyde
   i. Benzophenone oxime
   j. Sulfanilamide
   k. Phenothiazine
   l. 2,3-Diphenyl quinoxaline
   m. Benzimidazole
   n. Phenyl urea and Diphenyl urea
   o. Benzofuran

2. The following demonstration experiments to be arranged:
   a. Solving problems based on QSAR
   b. Molecular modeling

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**(9S02206) ADVANCED NATURAL PRODUCTS CHEMISTRY PRACTICAL**

**1.** Isolation and characterization of

1. Eugenol from Clove
2. Curcumin from Turmeric
3. Sennosides from senna
4. Hesperidine from Orange Peel
5. Embelin from Embellia Ribes
6. Glycyrrhizin from Glycyrrhiza Glabra
7. Plumbagin from Plumbago Rosea
8. Solanine from potatoes
9. Naringen from Grape Fruit Peel
10. Trimyristin and Myristin from Nutmeg
11. Azylic acid from Castor Oil
12. Pectin from Orange Peel
13. Lycopene from Tomato Peel
14. Epicatechin from Cashew Kernel outer covering
15. Piperine from Black pepper Degradation reaction of following natural products and the identification of the degraded intermediates by micro TLC and qualitative test. Atropine, caffeine, Ephedrine, aponification of Trimyristin.

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**(9S02207) Mini Projects-II:**

The mini projects can be taken up as industrial visit/training and report submission.

Or

A suitable project shall be carried out in the college.

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**M. Pharm IV semester Pharmaceutical Chemistry** **C 2**

**(9S02401) SEMINAR**

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**M. Pharm IV semester Pharmaceutical Chemistry** **C 16**

**(9S02402) PROJECT WORK**

The Project Work should be on a contemporary topic relevant to the core subjects of the course. It should be original work of the candidate.

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