# ACADEMIC REGULATIONS
# COURSE STRUCTURE AND
# DETAILED SYLLABUS

## DEPARTMENT OF CHEMISTRY

*For*

## M.Sc. Organic Chemistry
(Two Year **Full Time** Programme)


**JNTUH COLLEGE OF ENGINEERING HYDERABAD**
**(Autonomous)**
Kukatpally, Hyderabad – 500 085, Telangana, India.

**2015**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**COLLEGE OF ENGINEERING HYDERABAD**
**(AUTONOMOUS)**
**Kukatpally, Hyderabad – 500 085**

ACADEMIC REGULATIONS 2015
For CBCS Based M.Sc (Regular/Full Time) Program
(Effective for the students admitted into I year from the
Academic Year 2015**-16** and onwards)

**1.0 Post-Graduate Degree Program in M.Sc (PGP in M.Sc):**
JNTUH offers 2 Year (4 Semesters) full-time **Master of Science** (M.Sc) Degree Programs, under Choice Based Credit System (CBCS) at its Constituent Autonomous College - JNTUH College of Engineering Hyderabad with effect from the Academic Year 2015 - 16 onwards.

**2.0 Eligibility for Admission:**

2.1 Admissions to the PGPs shall be made subject to the eligibility, qualifications and specializations prescribed by JNTUH College of Engineering Hyderabad, JNT University Hyderabad, for each Specialization under each M.Sc. Program, from time to time.

2.2 Admission to the PGP shall be made either on the basis of an Entrance Test conducted by the Jawaharlal Nehru Technological University Hyderabad / on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the Government from time to time.

2.3 The medium of instructions for all PG Programmes will be ENGLISH only.

**3.0 M.Sc Program Structure:**

3.1 The M.Sc Program in Physics, Chemistry and Mathematics of JNTUH-CEH are of Semester Pattern, with 4 Semesters constituting 2 Academic Years, each Academic Year having TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

3.2 UGC/ AICTE specified Definitions/ Descriptions are adopted appropriately for various terms and abbreviations used in these PGP - Academic Regulations.

3.2.1 **Semester Scheme:**
Each Semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab Course', or 'Design/ Drawing Subject', or 'Seminar', or 'Comprehensive Viva', or 'Project', as the case may be.

3.2.2 **Credit Courses:**

All Subjects (or Courses) are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a L: T: P: C (Lecture Periods: Tutorial Periods: Practicals Periods : Credits) Structure, based on the following general pattern.

3.2.3 **Course Nomenclature:**

The curriculum nomenclature or Course structure grouping for M.Sc Degree Program is as listed below

Each subject is assigned certain number of credits as specified below.

| | | |
|---|---|---|
| Theory Subjects | 4 Periods / Week | 3 or 4 Credits |
| Practical subjects | 6 Periods / Week | 2 Credits |
| Practical subjects | 8 Periods / Week | 3 Credits |
| Seminar | 2 Periods / Week | 1 Credit |
| Project | | 3 or 4 Credits |

(Each period will be of 50 minutes duration)

**4.0 Course Work:**

4.1 A Student, after securing admission, shall pursue and complete the M.Sc PGP in a minimum period of 2 Academic Years (4 Semesters), and within a maximum period of 4 Academic Years (starting from the Date of Commencement of I Year).

4.2 Each student shall Register for and Secure the specified number of Credits required for the completion of the PGP and Award of the M.Sc Degree in respective Branch with the chosen Specialization.

4.3 I Year is structured to provide typically 22 Credits (22 C) in each of the I , II and III Semesters, and IV Semester comprises of 24 Credits (24 C), totaling to 90 Credits (90 C) for the entire M.Sc Program.

**5.0 Course Registration:**

5.1 A 'Faculty Advisor' shall be assigned to each M.Sc Program with respective Specialization, who will advise the Students about the M.Sc Program Specialization, its Course Structure and Curriculum, Choice/ Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

**6.0 Attendance Requirements:**

6.1 A Student shall be eligible to appear for the End Semester Examination (SEE) of any Subject, if he acquires a minimum of 75% of attendance in that Subject for that Semester.

6.2 A Student's Seminar Report and Seminar Presentation shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar Presentation Classes during that Semester.

6.3 Condoning of shortage of attendance up to 10% (65% and above, and below 75%) in each Subject or Seminar of a Semester may be granted by the College Academic Council on genuine and valid grounds, based on the Student's representation with supporting evidence.

6.4 A stipulated fee per Subject/Seminar shall be payable towards condoning of shortage of attendance.

6.5 Shortage of Attendance below 65% in any Subject/Seminar shall in NO case be condoned.

6.6 A Student, whose shortage of attendance is not condoned in any Subject(s) or Seminar in any Semester, is considered as 'Detained in that Subject(s)/ Seminar', and is not eligible to take End Examination(s) of such Subject(s) (and in case of Seminars, his Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he has to seek Re-registration for those Subject(s)/Seminar in subsequent Semesters, and attend the same as and when offered.

**7.0 Academic Requirements:**

The following Academic Requirements have to be satisfied, in addition to the Attendance Requirements mentioned in Item No. 6**.**

7.1 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course, if he secures not less than 40% Marks (28 out of 70 Marks) in the End Semester Examination, and a minimum of 50% of Marks in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing B Grade or above in that Subject.

7.2 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to - Seminar, and Comprehensive Viva-voce, if he secures not less than 50% of the total Marks to be awarded for each. The Student would be treated as failed, if he - (i) does not attend the Comprehensive Viva-voce as per the schedule given, or (ii) does not present the Seminar as required, or (ii) secures less than 50% of Marks ( < 50 Marks) in -Seminar/ Comprehensive Viva-voce evaluations.
She/ he may reappear for comprehensive viva where it is scheduled again; For seminar, he has to reappear in the next subsequent Semesters, as and when scheduled.

7.3 A Student shall - register for all Subjects covering 90 Credits as specified and listed in the Course Structure for the chosen PGP Specialization, put up all the Attendance and Academic requirements for securing 90 Credits obtaining a minimum of B Grade or above in each Subject, and 'earn all 90 Credits securing SGPA $\geq$ 5.0 ( in each Semester) and final CGPA (ie., CGPA at the end of PGP) $\geq$ 5.0, to successfully complete the PGP.

7.4 Marks and Letter Grades obtained in all those Subjects covering the above specified 90 Credits alone shall be considered for the calculation of final CGPA, which shall be indicated in the Grade Card of II Year II Semester.

7.5 Students who fail to earn 90 Credits as per the specified Course Structure, and as indicated above, within 4 Academic Years from the Date of Commencement of their I Year, shall forfeit their seats in M.Sc Program and their admissions shall stand cancelled.

7.6 When a Student is detained due to shortage of attendance in any Subject(s)/Seminar in any Semester, no Grade Allotment will be done for such Subject(s)/Seminar, and SGPA/ CGPA calculations of that Semester will not include the performance evaluations of such Subject(s)/Seminar in which he got detained. However, he becomes eligible for re-registration of such Subject(s)/Seminar (in which he got detained) in the subsequent Semester(s), as and when next offered, with the Academic Regulations of the Batch into which he gets readmitted, by paying the stipulated fees per Subject. In all these re-registration cases, the Student shall have to secure a fresh set of Internal Marks (CIE) and End Semester Examination Marks (SEE) for performance evaluation in such Subject(s), and subsequent SGPA/ CGPA calculations.

7.7 A Student eligible to appear in the End Semester Examination in any Subject, but absent at it or failed (failing to secure B Grade or above), may reappear for that Subject at the supplementary examination as and when conducted. In such cases, his Internal Marks (CIE) assessed earlier for that Subject/ Course will be carried over, and added to the marks to be obtained in the supplementary examination, for evaluating his performance in that Subject.

**8.0 Evaluation - Distribution and Weightage of Marks:**

8.1 The performance of a Student in each Semester shall be evaluated Subject-wise (irrespective of Credits assigned) with a maximum of 100 Marks for Theory, Practicals and 50 marks for Seminar.

8.2 a) For Theory Subjects, CIE Marks shall comprise of - Mid-Term Examination Marks (for 25 Marks), and Assignment Marks (for 5 Marks) for total of 30 marks.
b) During the Semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 25 Marks (with 120 minutes duration). The better performance out of these two Mid-Term Examinations shall be considered for the award of 25 Marks.

8.3 For Practical Subjects, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 Internal Marks, and 70 Marks are assigned for Lab./Practicals End Semester Examination (SEE). Out of the 30 Marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 Marks; and the performance in an internal Lab./Practical Test shall be evaluated for 10 marks. The SEE for Lab./ Practicals shall be conducted at the end of the Semester by the concerned Lab. Teacher and another faculty member of the same Department as assigned by the Head of the Department.

8.4 There shall be a Seminar Presentation in I Semester II Semester and III Semester. For the Seminar, the Student shall collect the information on a specialized topic, and submit to the Department which shall be evaluated by a Departmental committee consisting of the Head of the Department and two faculty members both appointed by HOD at the time of Seminar Presentation. The Seminar Presentation shall be evaluated for 50 Marks. There shall be no SEE or External Examination for Seminar.

8.5 a) Every PGP Student shall be required to execute his M.Sc Project, under the guidance of the Supervisor assigned to him by the Head of Department. The PGP Project shall start immediately after the completion of the II Year I Semester, and shall continue through II Year II Semester. The Student shall carry out the literature survey, select an appropriate topic and submit a Project Proposal within 2 weeks (immediately after his II Year I Semester End Examinations), for approval by the Project Review Committee (PRC). The PRC shall be constituted by the Head of Department, and shall consist of the Head of Department, Project Supervisor, and a Senior Faculty Member of the Department both appointed by HOD. The Student shall submit his/ her Project Work Proposal to the PRC, on whose approval he can 'REGISTER for the PG Project'. Every Student must compulsorily register for his M.Sc Project Work, within the 2 weeks of time-frame as specified above. After Registration, the Student shall carry out his work, and continually submit 'a fortnightly progress report' to his Supervisor throughout the Project period. The PRC will monitor the progress of the Project Work Presentation and submission of M.Sc Project Work Report/ Dissertation.

b) The PRC shall evaluate the entire performance of the Student and declare the Project Report as 'Satisfactory' or 'Unsatisfactory'.

8.6 a) In cases, where the Board declared the Project Work Performance as 'unsatisfactory', the Student is deemed to have failed in the Project Viva-voce Examination, and he has to reappear for the Viva-voce Examination as per the Board recommendations. If he fails in the second Viva-voce Examination also, he will not be considered eligible for the Award of the Degree, unless he is asked to revise and resubmit his Project Work by the Board within a specified time period.

**9.0 Re-Admission / Re-Registration:**

9.1 **Re-Admission for Discontinued Students:**
Students, who have discontinued the M.Sc Degree Program due to any reasons what so ever, may be considered for 'Readmission' into the same Degree Program (with same specialization) with the Academic Regulations of the Batch into which he gets readmitted, with prior permission from the concerned authorities, subject to Item 4.1.

**9.2 Re-Registration for Detained Students:**
When any Student is detained in a Subject (s)/ Seminar due to shortage of attendance in any Semester, he may be permitted to re-register for the same Subject in the 'same category' (Core or Elective Group) or equivalent Subject if the same Subject is not available, as suggested by the Board of Studies of that Department, as when offered in the sub-sequent Semester(s), with the Academic Regulations of the Batch into which he seeks re-registration , with prior permission from the concerned authorities, subject to Item 4.1.

**10.0 Grading Procedure:**

10.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks

obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

10.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

| *% of Marks Secured (Class Intervals)* | *Letter Grade (UGC Guidelines)* | *Grade Points* |
|---|---|---|
| 80% and above ( ≥ 80% , ≤ 100% ) | O (Outstanding) | 10 |
| Below 80% but not less than 70% ( ≥ 70% , < 80% ) | $A^+$ (Excellent) | 9 |
| Below 70% but not less than 60% ( ≥ 60% , < 70% ) | A (Very Good) | 8 |
| Below 60% but not less than 55% ( ≥ 55% , < 60% ) | $B^+$ (Good) | 7 |
| Below 55% but not less than 50% ( ≥ 50% , < 55% ) | B (above Average) | 6 |
| Below 50% ( < 50% ) | F (FAIL) | 0 |
| **Absent** | **Ab** | **0** |

10.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

10.4 A Letter Grade does not imply any specific % of Marks.

10.5 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

**Credit Points (CP) = Grade Point (GP) x Credits …. For a Course**

10.6 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

**SGPA = { $\sum_{i=1}^{N} C_i G_i$ } / { $\sum_{i=1}^{N} C_i$ } …. For each Semester**,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), $C_i$ is the no. of Credits allotted to the $i^{th}$ Subject, and $G_i$ represents the Grade Points (GP) corresponding to the Letter Grade awarded for that $i^{th}$ Subject.

10.7 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses

in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year first semester onwards, at the end of each Semester, as per the formula

**CGPA = { $\sum_{j=1}^{M} C_j G_j$ } / { $\sum_{j=1}^{M} C_j$ } … for all S Semesters registered (ie., upto and inclusive of S Semesters, S ≥ 1 )**,

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the Semester S ( obviously M > N ), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), $C_j$ is the no. of Credits allotted to the $j^{th}$ Subject, and $G_j$ represents the Grade Points (GP) corresponding to the Letter Grade awarded for that $j^{th}$ Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

10.8 For Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs will be used.

10.9 For Calculations listed in Item 10.5 – 10.8, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

10.10 **Passing Standards :**

10.10.1 A student shall be declared successful or 'passed' in a Semester, only when he gets a SGPA ≥ 5.00 (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire PGP, only when gets a CGPA ≥ 5.00; subject to the condition that he secures a GP ≥ 6 (B Grade or above) in every registered Subject/ Course in each Semester (during the entire PGP) for the Degree Award, as required.

10.10.2 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned etc.), Credits earned, SGPA, and CGPA.

## 11.0 Declaration of Results:

11.1 Computation of SGPA and CGPA are done using the procedure listed in 10.5 – 10.8.

11.2 For Final % of Marks equivalent to the computed CGPA, the following formula may be used ..

**% of Marks = (CGPA – 0.5) x 10**

## 12.0 Award of Degree and Class:

12.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **90** Credits (with GP ≥ 6.0), shall be declared to have

'QUALIFIED' for the award of the M.Sc Degree in the chosen specialization as he/ she admitted.

12.2 **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following four classes based on the % CGPA:

| Class Awarded | CGPA |
|---|---|
| First Class with Distinction | ≥ 7.75 |
| First Class | 6.75 ≤ CGPA < 7.75 |
| Second Class | 6.0 ≤ CGPA < 6.75 |

12.3 A student with final CGPA (at the end of the PGP) < 6.00 will not be eligible for the Award of Degree.

**13.0 Withholding of Results:**

13.1 If a Student has not paid fees to University/ College at any stage, or has pending dues against his name due to any reason whatsoever, or if any case of indiscipline is pending against him, the result of the Student may be withheld, and he will not be allowed to go into the next higher Semester. The Award or issue of the Degree may also be withheld in such cases.

**14.0 Transitory Regulations:**

14.1 A Student - who has discontinued for any reason, or who has been detained for want of attendance as specified, or who has failed after having undergone PGP, may be considered eligible for readmission to the same PGP with same set of Subjects/ Courses (or equivalent Subjects/ Courses as the case may be), and same Professional Electives (or from same set/category of Electives or equivalents as suggested), as and when they are offered (within the time-frame of 4 years from the Date of Commencement of his I Year I Semester).

**15.0 Student Transfers:**

15.1 There shall be no Branch/ Specialization transfers after the completion of Admission Process.

15.2 There shall be no transfer among the Constituent Colleges and Units of Jawaharlal Nehru Technological University Hyderabad.

**16. MALPRACTICES RULES:**

| | Nature of Malpractices | 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. |
| 1 (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. |
| 3 | 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 examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him. |
| 4 | Smuggles in the Answer book or | Expulsion from the examination hall and |

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|---|---|---|
| | 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. | 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 examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 5 | 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. |
| 6 | 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. |
| 7 | 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 examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 8 | 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. |
| 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. Person(s) who do not belong to the College will be handed over to police and, a 8police case will be registered against them. |
| 10 | 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. |
| 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 College / University for further action to award suitable punishment. | |

**17. GENERAL:**

- **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- **Credit Point:** It is the product of grade point and number of credits for a course.
- The Academic Regulations should be read as a whole for the purpose of any interpretation.
- The University/College reserves the right of altering the Academic Regulations and/or Syllabus/Course Structure, as and when necessary. The modifications or amendments may be applicable to all the candidates on rolls, as specified by the University/College.
- Wherever the words 'he' or 'him' or 'his' occur in the above regulations, they will also include 'she' or 'her' or 'hers'.
- Wherever the word 'Subject' occurs in the above regulations, it implies the 'Theory Subject', 'Practical Subject' or 'Lab.' and 'Seminar'.
- In case of any ambiguity or doubt in the interpretations of the above regulations, the decision of the Vice-Chancellor will be final.

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**JNTUH COLLEGE OF ENGINEERING HYDERABAD**
**M.Sc. Organic Chemistry (Full Time) w.e.f. 2015-16**

**I YEAR** **I-SEMESTER**

| S.No. | Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | OCY 15 101 | Physical Chemistry - I | 4 | 0 | 0 | 4 |
| 2 | OCY 15 102 | Inorganic Chemistry – I | 4 | 0 | 0 | 4 |
| 3 | OCY 15 103 | Organic Chemistry - I | 4 | 0 | 0 | 4 |
| 4 | OCY 15 104 | **Electives:**<br>i) Environmental Chemistry<br>ii) Chemistry of Engineering Materials | 4 | 0 | 0 | 3 |
| 5 | OCY 15 L11 | Physical Chemistry Lab - I | 0 | 0 | 6 | 2 |
| 6 | OCY 15 L12 | Inorganic Chemistry Lab- I | 0 | 0 | 6 | 2 |
| 7 | OCY 15 L13 | Organic Chemistry Lab - I | 0 | 0 | 6 | 2 |
| 8 | | Seminar-I | | | | 1 |
| | | | | | | **22** |

**I YEAR** **II-SEMESTER**

| S.No. | Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | OCY 15 201 | Physical Chemistry - II | 4 | 0 | 0 | 4 |
| 2 | OCY 15 202 | Inorganic Chemistry - II | 4 | 0 | 0 | 4 |
| 3 | OCY 15 203 | Organic Chemistry - II | 4 | 0 | 0 | 4 |
| 4 | OCY 15 204 | **Electives:**<br>i) Analytical Chemistry<br>ii) Soft skills development & practice | 4 | 0 | 0 | 3 |
| 5 | OCY 15 L21 | Physical Chemistry Lab - II | 0 | 0 | 6 | 2 |
| 6 | OCY 15 L22 | Inorganic Chemistry Lab - II | 0 | 0 | 6 | 2 |
| 7 | OCY 15 L23 | Organic Chemistry Lab - II | 0 | 0 | 6 | 2 |
| 8 | | Seminar-II | | | | 1 |
| | | | | | | **22** |

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**
**M.Sc. Organic Chemistry (Full Time) w.e.f. 2015-16**

**II YEAR** **I-SEMESTER**

| S.No. | Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | OCY 15 301 | Bioorganic Chemistry | 4 | 0 | 0 | 4 |
| 2 | OCY 15 302 | Chemistry of Synthetic Reagents & Patent Rights | 4 | 0 | 0 | 4 |
| 3 | OCY 15 303 | Organic Spectroscopy | 4 | 0 | 0 | 4 |
| 4 | OCY 15 304 | **Elective**:<br>i)Chemistry of Polymers<br>ii) Chemistry of Pesticides | 4 | 0 | 0 | 3 |
| 5 | OCY 15 L31 | Extraction of Natural Products & preparation of polymers Lab | 0 | 0 | 6 | 2 |
| 6 | OCY 15 L32 | Instrumental Methods of Analysis & Computational Chemistry Lab | 0 | 0 | 6 | 2 |
| 7 | OCY 15 L33 | Multi-Step Syntheses Lab | 0 | 0 | 6 | 2 |
| 8 | | Seminar-III | | | | 1 |
| | | | | | | **22** |

**II YEAR** **II-SEMESTER**

| S.No. | Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | OCY 15 401 | Organic Synthesis | 4 | 0 | 0 | 4 |
| 2 | OCY 15 402 | Photochemistry & Pericyclic Reactions | 4 | 0 | 0 | 4 |
| 3 | OCY 15 403 | Total Synthesis of advanced Natural Products | 4 | 0 | 0 | 4 |
| 4 | OCY 15 404 | **Elective:**<br>i)Drug design and Advanced Medicinal Chemistry<br>ii) Green Chemistry | 4 | 0 | 0 | 3 |
| 5 | OCY 15 L41 | Drug Analyses & Green Chemistry Lab | 0 | 0 | 6 | 2 |
| 6 | OCY 15 L42 | Spectroscopy Lab | 0 | 0 | 6 | 2 |
| 7 | OCY 15 444 | Project | 0 | 0 | 6 | 4 |
| 8 | | Seminar-IV | | | | 1 |
| | | | | | | **24** |

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

### PHYSICAL CHEMISTRY-I (OCY 15 101)

**Objectives:**

The student should

understand the role of thermodynamics and kinetics play in chemical equilibrium and the concepts used to make predictions and give explanations about chemical systems and fundamental properties of matter. He should develop familiarity with the physical concepts and the mathematical methods of quantum mechanics, photochemical reactions and principles of distribution laws.

**Unit-1 : Thermodynamics – I**

Brief review of concepts of I and II laws of thermodynamics. Concept of entropy, entropy change in reversible and irreversible processes. Entropy changes in an ideal gas. Entropy change with temperature, pressure and volume. Entropy change in phase transformation. Maxwell thermodynamic relations. Helmholtz and Gibbs free energies ( A and G) . Criteria for reversible and irreversible processes in terms of A & G. Physical significance of A & G. Gibbs -Helmholtz equation . Third law of thermodynamics. Nernst heat theorem. Determination of absolute entropies of solids . Limitation of third law of thermodynamics.

**Unit-2 : Photochemistry & Distribution law**

**Photochemistry** : Laws of Photochemistry- Lambert-Beer's law, Grotthus – Draper law, Stark-Einstein's law of photochemical equivalence. Quantum Yield – Quantum yield determination, photochemical reactions-high and low quantum yield reactions, Joblonski diagram – Fluorescence, Phosphorescence, Internal conversion, inter system crossing, delayed fluorescence. Chemiluminescence.

**Distribution law:** Nernst distribution law - Deviation of distribution law due to molecular complexity (Hit & Trial method & logarithmic method) - Applications of distribution law.

**Unit-3: Quantum Mechanics**

Black body radiation – Planck's concept of quantization – Planck's equation, average energy of an oscillator ( derivation not required). Wave particle duality and Uncertainity principle. Postulates of quantum mechanics. Schrodinger wave equation for hydrogen atom. Physical significance of wave function, Eigen functions ,Eigen values and quantum mechanical operators. Normalisation, Orthogonality and degeneracy. Particle in a box – one dimensional and three dimensional.

**Unit-4: Chemical Kinetics**

Theories of Reaction rates- Collision theory and Transition state theory. Theory of unimolecular reactions – Lindemann's theory. Kinetics of photochemical reactions: Chain reactions and their characteristics . Steady state treatment- dissociation of HI, reaction between $H_2$ & $Br_2$ and $H_2$ & $O_2$.

**Unit-5: Physical Organic Chemistry:**

Acids and Bases; HSAB principles; Kinetic versus Thermodynamic control, Hammett equation; Linear free energy relationships, Hammond's postulates.

**Outcomes:** The student will learn identify and describe energy exchange process and understands and can solve quantum mechanics problems. He gets awareness with the significant applications of photochemistry and distribution laws and analyse experimental data and draw appropriate conclusions from data and chemical theories.

**Recommended Books:**

1. "*Advanced Physical Chemistry*" , Gurudeep Raj; Goel Publishing House, Meerut **(**24th Edition, 1999).

2. "*Physical Chemistry*", Samuel Glasstone and D. Lewis; Mc Millan India Ltd., New Delhi**(**2nd Edition, 1984).

3. "*Physical Chemistry*", Peter Atkins and J.D.Paula; ELBS, Low Price Edition (7th Edition, 2002).

4. "*Chemical Kinetics*", K.J.Laidler; Tata Mc Graw- Hill Publishing Company Ltd, New Delhi (2nd Edition, 1984).

5. "*Principles of Physical Chemistry*" , Maron and Prutton; Oxford and IBH Publishing Co Pvt Ltd., New Delhi and Calcutta (4th Edition, 1966).

6. "*Catalysis- Principles and Applications*" , B.Vishwanathan, S.Sivasanker; Narosa Publications, New Delhi (2002).

7. "*Essentials of Physical Chemistry*", Bahl, Tuli and Arun bahl; S. Chand and Company Ltd. New Delhi **(**Revised Edition, 2009).

8. "*Physical Chemistry*", Gordon M Barrow, Tata Mc Graw- Hill Publishing Company Ltd, New Delhi (5th Edition, 2008).

9. "*Physical Chemistry*" Thomas Engel & Philip Reid, Pearson Education.

10. "*Physical Chemistry*", David W. Ball, Thomson Brooks/Cole, (1st Edition, 2007)

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

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## INORGANIC CHEMISTRY – I (OCY 15 102)

**Objectives:**
The course is intended to give thorough information on crystal field theory, stability of metal complexes in solution. Reaction mechanism of metal complexes, therapeutic importance of metal complex and the biological significance of various metal ions systems.

**Unit-1: Bonding in metal complexes**
Crystal field theory(CFT)-Salient features – Splitting of d-orbitals in Linear, Trigonal planar, Trigonal bipyrimidal, Square planar, Tetrahedral, Octahedral and Tetragonally distorted octahedral geometries - Jahn-Tellar theorem. Factors influencing the magnitude of crystal field splitting in octahedral complexes – Nature of metal ions, nature of ligands – Spectrochemical series and geometry. Calculation of Crystal field stabilization energies (CFSE) in four and six coordinated complexes. Uses of CFSE values in stabilization of Oxidation states, geometry of complexes and heats of hydration of Transition metal ions. Magnetic properties of transition metal (octahedral) complexes - Calculation of magnetic moments using Spin-only formula.

**Unit-2: Formation and Stability of Metal Complexes in Solution**
Thermodynamic stability, Kinetic Stability – Binary metal complexes**:** Step-wise and overall formation or stability constants and their interrelationship. Ternary complexes: Step wise and simultaneous equilibria; Factors influencing the stability of complexes – Ligand effects: Basicity, chelate effect and steric factors. Metal ion effects: Ionic potential, Crystal field effects and natural order and effective nuclear charge. Determination of stability constants of metal complexes by $P^H$-metric and Spectrophotometric methods (Principle only).

**Unit-3: Reaction mechanisms of Metal complexes**
Energy profile of a reaction – Transition state or Activated complex – Types of substitution reactions – $S_E$ & $S_N$. Ligand substitution reactions in octahedral complexes: Aquation or acid hydrolysis reactions – Factors affecting acid hydrolysis, Base hydrolysis: Conjugate base mechanism, Evidences in favour of $S_N^lCB$ mechanism. Substitution reactions without breaking metal-ligand bond. Ligand substitution reactions in square planar complexes: mechanism –trans effect, polarization and pi-bonding theories, Applications of trans effect in the synthesis of Pt(II) complexes.Redox or electron transfer reactions: inner sphere and outer sphere mechanisms.

**Unit-4: Metal Complexes in Clinical Chemistry**
Metallo enzymes and their biochemical functions (brief survey) – diseases caused due to deficiency and excessive accumulation of metals – metal ion induced toxicity – $LD_{50}$ values of some toxic metals – Thermodynamic and pharmaco kinetic aspects of chelation therapy in metal ion detoxification – conditional stability constants, stereo chemical requirement, lipophilicity, HSAB theory. Conditions for urinary and bilary excretion
Theory and mode of action of therapeutic chelating agents, Single ligand chelation therapy, double ligand chelation therapy, synergistic chelation therapy, mixed ligand Chelation therapy –
Penicillamines, triethylene tetramine, aminopoly carboxylic acids (EDTA, CDTA, DTPA etc.), Antabuse – Limitations of Chelation therapy. Gold therapy in Rheumatoid Arthritis.

**Unit-5: Bio-Inorganic chemistry:**

Metal ions in biological systems: Basic principles in biological selection of elements, Importance of Na, K, Ca in Biological Processes. Oxygen uptake proteins: Haemoglobin, Myoglobin; Oxygen transport by Haemoglobin; Geometric and Magnetic aspects of dioxygen binding.

Metalloenzymes : Carbonic anhydrase and alcohol dehydrogenase – functions and mechanism of action.

**Outcomes**: After study of the course content the student would be able to thoroughly understand various aspects of bonding in metal complexes, CFT, CFS, CFSE of complexes, formation of metal complexes in solution and their stability, mechanism of various types of reactions in metal complexes. Therapeutic chelating agents, chelation therapy and importance of metallo enzymes and metal ions in biological systems.

**Recommended Books:**


1. *"Advanced Inorganic Chemistry*", F.A.Cotton, G.Wilkinson, C.A. Murillo and M.Bochmann, 6 th Edition, Wiley-Interscience, Newyork (1999**).**

2. "*Inorganic Chemistry*", J.E.Huheey, E.A.Keiter and R.L. Keiter 4th Edition, Pearson Education Asia, **(**2001**).**

3. *"Mechanism of Inorganic reactions*", M.L.Tobe and J.Burgess, Addison Wesley Longmann,(1999).

4. "*Bio-Inorganic chemistry", Inorganic Elements in the Chemistry of Life*", W.Kaim and B.Schwederski, John Wiley &Sons, NY (1999).

5. "*Selected topics in Inorganic chemistry*", W.U.Malik, G.D.Tuli &Madan, S.Chand &Co., Delhi (2002).

6. "*Outlines of Bio-Chemistry*" , E.E Cohn and Stumpf,John Wiley &Sons, NY (2000).

7. "*Metal ions in Reaction Mechanisms*", K.Veera Reddy, Galgotia Publications (P) Ltd.

8. "*Inorganic chemistry*" , Garry L Miessler, Pearson Education.**(** 3rd Edition ,2009).

9. "*Concise Coordination Chemistry* " , R.Gopalan and V.Ramalingam, Vikas Publishing House Pvt.Ltd., New Delhi.

10. "*A Text book on Medicinal aspects of Bio-Inorganic Chemistry*", A.K.Das, CBS Publishers and distributors, New Delhi.

11. "*Hand book of Metal-Ligand interactions in biological fluid medicine*", Vol. II : Edt. Guy Berthon.
12. Consise Inorganic chemistry by J. D. Lee (ELBS).


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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

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## ORGANIC CHEMISTRY-I (OCY 15 103)

**Objectives:**
The fundamental concepts of stereochemistry are required to understand Arymetric synthesis. The reactive intermediates and the principles required for better understanding reaction mechanism are needed. The knowledge of aromaticity is necessary for a Post Graduate student of Chemistry.

**Unit-1: Stereochemistry (Optical Isomerism, Geometrical & Conformational Isomerism):**
Introduction, significance and classification of isomers into structural and stereo types - Normal and Dynamic types - Optical Isomerism - Elements of symmetry and chirality - Configuration of optically active molecules - DL and RS notations - Relative and Absolute configurations- Resolution of Racemic mixtures. Stereospecific, stereoselective and Regiospecific, regeoselective reactions - Cram's rule - Optical Isomerism of Nitrogen compounds - Concept of dynamic enantiomerism. Cis-Trans isomerism; E-Z configuration - Interconversion of geometrical isomers and determination of their configuration; Geometrical isomerism of nitrogen compounds - Conformations of acyclic systems like ethane and n-butane and cyclic systems like cyclohexane-mono and di substituted cyclohexanes. Introduction to stereochemistry of biphenyl, allenes, spiro compounds.

**Unit-2: Aromaticity-I (Benzenoidal & Non-Benzenoidal Aromatic hydrocarbons):**
Aromaticity - Huckel's ($4n+2\pi$ electron rule) and its limitations - Classification of cyclic conjugated hydrocarbons as alternant and non- alternant, Benzenoidal hydrocarbons-Aromatic properties and general methods of synthesis of Naphthalene, Phenanthrene and Anthracene. Homo-aromatic and Anti-aromatic systems. General methods of synthesis and properties of Non-Benzenoidal aromatic compounds - Cyclopropenium salts, Cyclopentadienyl salts, Cycloheptatrienyl cation, Tropinone, Tropolone, Ferrocene and Azulenes.

**Unit-3: Reactive Intermediates:**
Classical and Non-Classical cabocations; Generation, Structure, Stability, detection and Reactivity of Carbonium ions and Carbanions; carbenes, free radicals, nitrenes, arynes Acetoacetic ester & Malonic ester synthesis.

**Unit-4: Study of Organic Reaction Mechanisms:**
Introduction, significance and general methods of study of mechanisms of Organic Reactions, Kinetic and non-kinetic methods; Use of isotopes; Cross-over experiments; Intermediate trapping; evidence based on stereochemistry etc; Examples.

**Unit-5: Addition to Carbon-Carbon multiple bonds:**Addition involving symmetrical and unsymmetrical reagents, addition of halogens to alkenes, evidence for halonium ion, intermediacy, stereo selectivity and specificity. Syn addition reagents lile $KMnO_4$, $OsO_4$, Anti addition- epoxidation followed by ring opening.

**Outcomes:**

The student learns the basic principles and concepts of stereochemistry and reaction mechanism from this course. He also get enough knowledge of aromaticity, reaction intermediates and addition to carbon, carbon multiple bonds.

**Recommended Books**:


1) "*Stereochemistry of Carbon Compounds*" by Ernest L.Eliel, Tata-Mc Graw Hill Co., New Delhi (1975). Indian Education in 2003.
2) "*Stereochemistry - Conformation and Mechanism*", by P.S. Kalsi, Wiley Eastern Ltd., New Delhi, Hyd. (1991).
3) "*Carbocyclic Non-Benzenoid Aromatic Compounds*", by Douglas Lloyd, Elsevier Publishing Company, Amsterdam, London, New York (1966).
4) "*Advanced Organic Chemistry*", by Jerry March, John Wiley & Sons, New York, London. (2001).
5) "*Organic Chemistry*", by R.T.Morison and R.N.Boyd, Allyn & Bacon Inc., (printed in Singapore) (2001).
6) "*University Chemistry*", Vols II & III by C.P.Murthy, S.F.Mehidi Ali and P.K. Dubey, New Age International (P) Ltd., New Delhi, Hyderabad (1996).
7) "*Organic Chemistry*", Vol.I, by S.M.Mukherji, S.P. Singh and H.P. Kapoor, Wiley Eastern Ltd., New Delhi, Hyderabad. (1985).
8) "*Organic Chemistry*", by Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt. Ltd., Delhi (2001).
9) "*Organic Reaction Mechanisms*", by Raj K. Bansal, Tata-Mc Graw Hill Co., New Delhi (1998).
10) "*A Guide-book to Mechanism in Organic Chemistry*", by Peter Sykes Orient Longmans Ltd., New Delhi (1976).
11) "*Mechanism and Theory in Organic Chemistry*", by T.H.Lowry and K.S. Richardson, Harper & Row Publishers, London (1988).
12) "*Organic Stereo-Chemistry*" by Henri Kagan, Edward Arnold Publishers, London (1979).
13) "*Advanced Organic Chemistry*" by Arun Bhal & B.S. Bhal, S. Chan Company Pvt. Ltd. New Delhi.
14) "*Organic Chemistry*" by Janice G. Smith, Tata McGraw Hill Company Ltd., 2nd Edition, 2008.
15) "*Organic Chemistry*" by Stanley H Pine, Tata McGraw Hill Company Ltd., 5th Edition, 2008.
16) "*Introduction to Organic Chemistry*" by Jhon Mc Murry, Cengage Pvt. Ltd. New Delhi, 2008.
17) Text book of organic chemistry by Carey & Sundberg.


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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

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### Elective-1 : ENVIRONMENTAL CHEMISTRY (OCY 15 104)

**Objectives**: The importance of Environmental Chemistry various aspects of environmental pollutions with necessary concepts are included. Various environmental issues which are on debate will be discussed in comprehensive manner.

**Unit-1: Environment and Biodversity:**
Introduction, Importance of environmental education, Components of environment and their interaction – Biogeochemical cycles – Water cycle, carbon cycle, oxygen cycle. Biodiversity and its conservation.

**Unit-2: Air Pollution:**
Classification of Air Pollutants and their emission sources. Physicochemical Pollutants- Oxides of Nitrogen, Sulphur, Hydrocarbons and their effects on health and environment. Greenhouse effect- Acid rain, Chlorofluoro carbons. Secondary Air Pollutants- Photochemical Reactions, Depletion of Ozone layer, PAN-Photochemical Smog, Effect of Gasoline on Air pollution. Control of CO, $NO_x$, $SO_x$ emissions. Catalytic Control devices for Automobiles, Cyclone Seperators, Filters, Electrostatic Precipitators.

**Unit-3: Soil & Pesticide Pollution:**
Sources of Soil Pollution , Classification of Soil Pollutants, Sources and Classification of Solid Waste, Solid Waste Management – Open Dumpling, Sanitary Land Fill, Incineration, Compositing, Recovery and Recycling of Solid Waste. Classification of Pesticides, Degradation of Pesticides, Control methods of Pesticide Pollution.

**Unit-4: Water and its Pollution:**
**Water:** Hardness of water, Types of hardness , causes of hardness , units of hardness . Determination of hardness by EDTA Method. Boiler troubles : Priming, foaming, scales, sludges and caustic embrittlement. Treatment of boiler feed water – Internal treatment (Calgon, carbonate and Phosphate conditioning) – External treatment- Lime Soda, Zeolite and Ion exchange processes – Numerical Problems. Potable Water - Characteristics , treatment , sterilization by chlorination – Break point chlorination, Ozonation .Desalination of water by Reverse Osmosis .

**Water Pollution**: Types of water pollutants and their effects - Measurement of BOD, COD, TOC. Chemical analysis of water - Alkalinity , Dissolved Oxygen.
**Waste Water Treatment** : Primary, Secondary and tertiary treatment methods. Fluorine contamination – Removal methods – Nalgonda Technique, membrane technology (defluoridation). Estimation of fluoride – Alizarin methods,

**Unit-5: Environmental monitoring methods:**
Environmental monitoring methods – Qualitative and quantitative analysis of trace metals by AAS. Detection and quantitative analysis of I and II group elements by Flame Photometry. Management of toxic inhalations – Hg and Salicylate intoxication.

**Outcome**: The student will gain knowledge on various environmental problems, various types of pollution and environmental monitoring methods which include AAS, HPLC, Flame photometry etc.

**Recommended Books:**

1. *" Engineering Chemistry"* , 15th Edition by P.C.Jain and Monika Jain, Dhanpat Raj Publishing Company, New Delhi (2005)
2. "*Environmental Chemistry*", V.P.Kudesia, Pragathi Prakashan, Meerut(2003).
3. "*Fundamental Concepts of Environmental Chemistry*", G.S.Sodhi, Narosa Publishing House Pvt. Ltd., New Delhi (2002).
4. *"Environmental Chemistry",* A.K.De,New Age International Publishers, New Delhi (2003).
5. *"An Introduction to Environmental Pollution*", B.K.Sharma and H.Kaur, Goel Publishing House, Meerut (1999)
6. "*Environmental Chemistry*", Ajay K.Bhagi & G.R.Chatwal, Himalaya Publishing House, New Delhi 2005
7. "*Environmental Chemistry",* S.K.Banerji,Prentice-Hall of India, New Delhi (1999).
8. *"Environmental Management* ", H.V.Jadhav & Purohit , Himalaya Publishing House, New Delhi 2008.
9. *'A text book of Environmental Studies*", G.R.Chatwal & Harish Sharma, Himalaya Publishing House, New Delhi (2008)

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

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### Elective-2 : CHEMISTRY OF ENGINEERING MATERIALS (OCY 15 104)

**Objectives:**
1. The student is made to understand the basic concepts of chemistry.
2. To inculcate the knowledge of various Engineering materials, nano materials, bio degradable polymers etc.

**Unit-1: Cement and Allied materials**:
Types of cements-Port land cement – composition –setting and hardening of port land cement ( chemical reactions involved) .Testing properties and ISI specifications of cement, gypsum, plaster of Paris and lime- manufacture of lime.

**Unit-II: Glass ceramics and porcelain:**
Glass –Physical and chemical properties of glass - raw materials- methods of manufacturing of glass – special glasses.
Ceramics: General properties of ceramics-raw materials-manufacture of ceramics-glaring in ceramics-applications of colours to the pottery.
Porcelain – raw materials –manufacture of Porcelain.

**Unit-III: Nano materials :**
Preparation and classification of Nano materials – Nano catalysis. Applications of Nano catalysts for organic transformations. Applications of Nano materials for biomedical, environmental and chemical areas.

**Unit-IV: Biodegradable polymers:**
Principles of biodegradation – Modes of biodegradation –Enzymatic degradation of biopolymers (polysaccharides), proteins, nucleic acids. Biodegradable polyamides-copolymers of α-amino acid
(glycine, serine), ε-aminocaproic acid. Benzyl substituted urethane – polyester urea – polyamide urethane – synthesis and properties. γ- polyglutamic acid, bacterial polymers. Applications – agriculture, medicine, packaging.

**Unit-V: Batteries:**
Classification-Primary(dry cell), secondary batteries ( Ni-Cd) cells. Fuel cells : Hydrogen-oxygen fuel cells; advantages of fuel cells.

**Outcomes:** The student will learn the concepts of types, testing properties of cements, abrasives, glass. Nano materials, biodegradable polymers, batteries etc. Biodegradable polymers, nano materials for various applications will be included.

**Recommended Books:**
1. "*Text Book of Engineering Chemistry"* B. Rama Devi, Mani, Misra, V. R. Reddy,

   Cengage Learning Pulications.
2. *" Engineering Chemistry"* , 15th Edition by P.C.Jain and Monika Jain, Dhanpat Raj Publishing Company, New Delhi (2005)

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

| L | T | P | C |
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## PHYSICAL CHEMISTRY LABORATORY - I (OCY -15-L11)

**I) Chemical Kinetics:**

a) Study of first order kinetics of hydrolysis of methyl acetate (acid catalysis).
b) Study of the hydrolysis of ester by alkali and study of the order of the reaction (ethyl acetate).
c) Study of the kinetics of reaction between acetone and iodine in acidic medium and determination of the order.
d) Determination of rate constant and order of reaction between potassium persulphate and KI.

**II) Phase rule:**

a) To study the phase diagram of simple binary system (Phenol / Water).
b) To construct the phase diagram of three component system containing (i)Ethanol, Benzene and Water (ii) Acetic acid, Chloroform and Water

**III) Distribution Law:**

a) To determine the Distribution Coefficient of benzoic acid between benzene and water.
b) To determine the Distribution Coefficient of acetic acid between benzene and water.

**IV) Adsorption:**

a) To determine the adsorption isotherm of acetic acid from aqueous solution of charcoal.
b) To determine the adsorption isotherm of oxalic acid on silica gel.

**Recommended Books**:

1. "*Senior Practical Physical Chemistry*" , B.D.Khosla, 6th edition V.C.Garg and A.Khosla, R.Chand & Co., Delhi (1991).
2. "*Practical Physical Chemistry*" , J.B.Yadav, 5th edition Krishna Prakash media Pvt Ltd, Meerut (1997).
3. "*Practical Physical Chemistry*" , B.Viswanathan, P.S.Raghavan, 1st edition Viva Books Pvt. Ltd (2005).
4. "*Experiments in Physical Chemistry*" , David P. Shoemaker, Carl W. Garland and Joseph W. Nibler, 5th edition Mc Graw-Hill Book Company (1989).

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

| L | T | P | C |
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## INORGANIC CHEMISTRY LABORATORY – I (OCY 15 L12)

### I) VOLUMETRIC ANALYSIS

i) ***Dichrometry***

a) Estimation of Hypo by Dichromate.
b) Estimation of Ferrous Iron.
c) Estimation of Ferric Iron.

ii) ***Permanganometry***

a) Estimation of Oxalic acid by Permanganate.
b) Estimation of Ferrous Iron.
c) Estimation of Ferric Iron.

iii) ***Iodometry***

a) Estimation of Copper.

iv) ***Cerimetry***

a) Estimation of Nitrite.

v) ***Complexometry***

a) Estimation of Total Hardness of water.
b) Estimation of Nickel by EDTA.
c) Estimation of Copper by EDTA.
d) Estimation of Calcium by EDTA.

vi) ***Precipitation Titrations***

a) Estimation of Zinc by Ferrocyanide method.

**Books Recommended:**

1) Vogel's "*Text book of Quantitative Chemical Analysis"* .
2) *"Advanced Inorganic Analysis*", Dr. S.C. Rastogi, S.K. Agarwal & Keemti Lal.
3) "Analytical Chemistry ", S. M. Khopkar.
4) *"Modern Experiments for Introductory Chemistry*", H.A. Neidig & W.J. Stratton.
5) *"A hand book of Analytical Chemistry* "Vol-1, Dr. S.C. Rastogi & S.K. Agarwal.

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year I-Sem (Organic Chemistry)**

| L | T | P | C |
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## ORGANIC CHEMISTRY LABORATORY - I (OCY 15 L13)

### Purification methods of organic compounds:

i) Purification of solids – Recrystallization, sublimation and fractional crystallization
ii) Purification of liquids – Distillation, fractional distillation, distillation at reduced pressure.
iii)Seperation of leaf pigments- ( Chlorophyll a, Chlorophyll b and xanthophylls ) by paper chromatography .
iv) Determination of purity of organic compounds : Using boiling point, melting point and mixed melting point

### Organic Preparations and Extractions:

i) Preparation of m-dinitrobenzene from nitrobenzene by nitration.
ii) Preparation of benzanilide from benzophenone via the oxime by Beckmann Rearrangement.
iii) Preparation of benzylideneacetophenone from benzaldehyde & acetophenone by Claisen-Schmidt Reaction.
iv) Cycloaddition of anthracene with maleic anhydride by Diels – Alder Reaction.
v) Preparation of benzoic acid and benzyl alcohol from benzaldehyde using Canizzaro's Reaction.
vi) Preparation of β-napthylbenzoate using β-napthol and benzoyl chloride using Schotten – Baumann reaction.
vii) Preparation of acetylsalicylic acid (aspirin) from salicylic acid.
viii) Preparation of hippuric acid from glycine and benzoyl chloride.
ix) Preparation of 7-hydroxy-4-methylcoumarin using resorcinol and ethyl acetoacetate.
x) Preparation of azalactone from hippuric acid.
xi) Preparation of tribromo aniline from aniline.
xii) Preparation of Tribromophenol from phenol.

### Recommended Books:

1) "*Quantitative and Qualitative analysis in Organic Chemistry*" ,Vogel.

2) "*Practical Organic Chemistry*", Mann and Saunders.

3) "*Laboratory Organic Manual*", R.K.Bansal.

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year II-Sem (Organic Chemistry)**

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### PHYSICAL CHEMISTRY –II (OCY 15 201)

**Objectives:**

The student should have a chemical potential and fagacity and he should understand applications of physical chemistry on colloidal systems and acquire a basic knowledge of electrode potentials, surface chemistry, electrochemical cells and understands methods for prediction and control of corrosion.

**Unit-1: Thermodynamics-II**

Partial molar properties – significance –determination of partial molar properties from intercept method and apparent molar properties method. Chemical potential- Variation of chemical potential with T and P. Gibbs-Duhem equation- derivation and significance. Chemical potential of pure ideal gas . Thermo dynamic function of mixing of ideal gases . Applications of the chemical potential. Concept of Fugacity- Fugacity coefficient, Determination of Fugacity- by Graphical method and Approximate calculation method. Concept of activity coefficient.

**Unit-2: Colloids & Surface Chemistry**

**Colloids:** Classification of colloids, preparation & purification of sols, properties of colloids-electrical properties, zeta potential and its measurement. Stability of sols and factors affecting their stability.

**Surface Chemistry:** Concept of adsorption, factors influencing adsorption. Adsorption isotherms – Freundlich , Langmuir , B.E.T theory of adsorption equation. Determination of surface area using B.E.T. method . Adsorption of gases on solids – Physisorption and chemisorption, Adsorption from solutions: Positive adsorption, negative adsorption, electrostatic adsorption, Gibbs adsorption. Applications of adsorption.

**Unit-3 : Phase rule:** Terms involved in phase rule – Derivation of phase rule – Phase diagrams of one component system ( Water and sulphur system), Two component system ( Lead-Silver system) and Iron carbon phase diagram. Heat treatment. Applications of Phase rule.

**Unit-4: Electro chemistry & Corrosion**

**Electrochemistry:** Electrochemical cells- Galvanic cell and electrolytic cell, Electro chemical conventions, Chemical cells, concentration cells, measurement of liquid junction potential , single electrode potential , Nearst equation and its applications – Numerical problems .

**Corrosion:** Definition, causes and affects of corrosion . Theories of corrosion – chemical and electro chemical corrosion- mechanism of electro chemical corrosion. Types of corrosion - Galvanic corrosion , concentration cell corrosion ( water line corrosion) ,

f actors affecting rate of corrosion ,protection against corrosion- Cathodic protection, Protective coatings – metallic coatings -anodic and cathodic coatings- Methods of application of metallic coatings dipping , cementation , cladding.

**Unit-5: Chemical Kinetics-II**

Kinetics in liquid solutions : Theory of absolute reaction rates applicable to reactions in ideal solutions, the reaction between ions in solution- Salt effect. Fast reactions - Kinetics of fast reactions, study of fast reactions by stopped flow method, relaxation method, Flash photolysis and Nuclear magnetic resonance method.

**Outcomes:** The student will be able to estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture and how to interpret and apply properties of colloids in application of colloidal chemistry. He gets the basic knowledge on equations of electrochemistry and their applications to electro- analysis and how to recognize the different forms of corrosion and able to design infrastructure, plant, equipment and machinery against corrosion.

**Recommended Books:**

1. *" Advanced Physical Chemistry" ,* Gurudeep Raj; Goel Publishing House, Meerut (24th Edition, 1999)
2. "*Physical Chemistry*", Samuel Glasstone and D.Lewis; Mc Millan India Ltd. New Delhi (2nd Edition, 1984)
3. *"Physical Chemistry* ",Peter Atkins and J.D.Paula; ELBS, Low Price Edition (7th Edition, 2002)
4. "*Chemical Kinetics*" , K.J.Laidler; Tata Mc Graw-Hill Publishing CompanyLtd, New Delhi (2nd Edition, 1984)
5. "*Principles of Physical Chemistry*", Maron and Prutton;Oxford and IBH Publishing Co. Pvt Ltd (New Delhi ) and Calcutta (4th Edition, 1966)
6. "*Catalysia Principles and Applications* " , B.Vishwanathan, S.Sivasanker; Narosa Publications, New Delhi (2002)
7. *"Essentials of Physical Chemistry"* Bahl, Tuli and Arun bahl; S.Chand and Company Ltd. New Delhi (Revised Edition, 2009)
8. "*Physical Chemistry"* ,Gordon M.Barrow Tata Mc Graw-Hill Publishing Company Ltd, New Delhi (5th Edition, 2008)
9. "*Physical Chemistry* ", Thomas Engel & Philip Reid, Pearson Education.
10. *" Physical Chemistry*" , David W.Ball, Thomson Broks/Cole, (1st Edition,2007)

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year II-Sem (Organic Chemistry)** **L T P C**
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## INORGANIC CHEMISTRY - II (OCY 15 202)

**Objectives:** The course is intended to give the concepts of point symmetry, electronic spectra of transition metal complexes, various organo metallic complexes and their catalytic applications, metal carbonyls and nitrosyls.

**Unit-1: Symmetry of molecules**
Concept of Symmetry in Chemistry- Symmetry Operations - Symmetry Elements : Rotational Axis of Symmetry and types of Rotational Axis. Plane of Symmetry and types of planes. Improper Rotational Axis of Symmetry,Inversion center and Identity element. Molecular Point Groups**:** Definition, Properties and Notation of Point Groups, Classification of Molecules into $C_1$,$C_s$,$C_i$ $C_n$, $C_{nv}$, $C_{nh}$ , $C_{\alpha v}$ and other point groups – Exercises in Molecular Point Groups –Symmetry criteria for Optical activity.

**Unit-2: Electronic spectra of Transition metal complexes**
Free ion terms and Energy levels: Configuration, Terms, States and Microstates-calculations for microsates $p^2d^2$ configurations; L-S (Russel-Saunders) coupling scheme,J-J coupling scheme- Derivation of terms for various $p^2d^2$ configurations.

**Selection rules:** Laporte orbital selection rule, spin selection rules. Spliting of energy lvels and spectroscopic states Orgel diagram for $d^1$ to $d^9$ metal complexes. Interpretation of electronic spectra of aquo complexes of T: (III), Cu(II). Charge transfer (L-M and M-L) spectra of complexes. Hole formalism-Energy ordering of terms ( Hund's rule)

**Unit-3: Organometallic compounds**
Classification of Organometallics based on hapticity. Classification of Organometallics based on Polarity; S-bonded Organometallics and p-bonded Organometallics; General methods of the preparation of Main-group and Transition metal Organometallics. Nature of M-C bond, Synthesis and Bonding. Two electron ligands (Olefinic & Acetylinic) complexes, Three electron ligands (Allylic) complexes, Four electron ligand(Butadiene and Cyclobutadiene) complexes, Five electron ligand -Ferrocene complex.

**Unit-4: Catalytic applications of Organo Transition Metal Complexes**
Oxidative addition and Reductive Elimination: Mechanism of Oxidative addition – Insertion reactions – Hydrogenation of Olefins by Wilkinson's Catalyst – Hydrosilation of Olefins – Isomerism of Olefins, Ziegler – Natta Polymerisation of Olefins – Oligomerization of Butadiene, hydroformylation of olefins–Oxidation of alkenes to aldehydes (Wakers process).

**Unit-5: Metal Carbonyls & Nitrosyls**
Metal Carbonyls: Carbon monoxide as ligand-Molecular orbitals of CO- Donor and Acceptor molecular orbitals of CO. Bonding modes of CO-Terminal and Bridging. Classification onto low and high nuclearity carbonyl clusters. 18 Valence electron rule and its application to low nuclearity carbonyl clusters. Structures of $Ni(CO)_4$, $Cr(CO)_6$, $Mn_2(CO)_{10}$ ,$Fe_2(CO)_9$ , $Co_2(CO)_8$ and $M_3(CO)_{12}$ & $M_4(CO)_{12}$ ( M= Fe,Ru,Os). Synthesis of Acetic acid by $Co_2(CO)_8$ as catalyst.

Metal Nitrosyls: NO as a ligand – Molecular orbitals of NO – Donor and Acceptor components, Bonding modes of NO – Terminal (Linear, Bent) and Bridging; Structural aspects of $[IrCl(PPh_3)_2(CO)(NO)]^+$ and $[RuCl(PPh_3)_2(NO)_2]^+$.

**Outcomes:** After studying the course content, **t**he student would be able to understand concept of point symmetry, symmetry operations, symmetry elements, symmetry point groups. Electronic spectra of transition metal complexes, organotransition metal complexes and their catalytic applications, structure and bonding of metal carbonyls and nitrosyls.

**Books Recommended:**


1. "*Symmetry and Spectroscopy of Molecules*", K.Veera Reddy, New Age International (P) Ltd. Publishers, 2nd Edition (2009).
2. "*Advanced Inorganic Chemistry",* F.A.Cotton, G.Wilkinson, C.A. Murillo and M.Bochmann, 6th Edition, Wiley-Interscience, Newyork (1999**).**
3. *"Inorganic Chemistry*", J.E.Huheey, E.A.Keiter, 4th Edition, Pearson Education Asia**,(**2001**).**
4. *"Mechanism of Inorganic reactions*", M.L.Tobe and J.Burgess, Addison Wesley Longmann (1999).
5. *"Selected topics in Inorganic chemistry*", W.U.Malik, G.D.Tuli &Madan, S.Chand & Co., Delhi (2002).
6. "*Inorganic chemistry"* , Garry L Miessler, Pearson Education**.(** 3rd Edition, 2009**).**
7. *"Concise Coordination Chemistry*", RGopalan and V.Ramalingam, Vikas Publishing House Pvt.Ltd., New Delhi.
8. "*Organometallic Chemistry* " , R.C.Mehrotra & A. Singh, New Age International (P) Ltd. Publishers.
9. "*Introduction to Ligand fields",* B N Figgis, Wiley Eastern Ltd, New Delhi.
10) "*Organotransition metal chemistry fundamental concepts and applications*", John Akio Yamamato, Wiley & Sons.
11. *"Applied Homogeneous Catalysis with organometallic compounds*" Vol. I & Vol. II, Boy Cornills and W A Herrmann – VCH.
12. "*Organo metallic compounds*", G E Coates, M C H Green, K Wade Vol. II.


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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year II-Sem (Organic Chemistry)**

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### ORGANIC CHEMISTRY - II (OCY 15 203)

**Unit-1: Reaction Mechanism – I:**
Aromatic nucleophilic substitutions – $S_N1$ , $S_N2$ and benzyne mechanisms with evidences. Neighbouring group participation of oxygen, sulphur and $\sigma$, $\prod$ bonds – (anchimeric assistance, retention of configuration.) Introduction to non-classical carbocations – Von-Ritcher rearrangement.

**Unit-2: Heterocyclic Compounds – I:** Importance, synthesis, reactivity, aromatic character of imidazole,pyrazole, oxazole, thiazole, isoxazole, isothiazole, pyridazine, pyrimidine, pyrazine.

**Unit-3: Heterocyclic Compounds – II:** Importance, synthesis, reactivity of Indole, benzofuran, benzo thiazole,quinoline, isoquinoline, benzimidazole, Coumarine, chromones.

**Unit-4: Molecular Rearrangements-I:**
Definition and Classification; General mechanism of Molecular rearrangements; Nucleophilic, Electrophilic, Free-radical Rearrangements - Examples; Whitmore - 1, 2– shifts, Stereochemical implications. Molecular rearrangements involving Carbocations; Wagner-Meewein, Pinacol, Allylic, Wolff, Arndt-Eister. Demjanov, Dienone-Phenol Rearrangements.

**Unit-5: Molecular Rearrangements-II:**
Molecular rearrangements involving electron - deficient oxygen – Baeyer-Villiger oxidation, Base catalysed rearrangements Favorskii rearrangement and Benzilic acid smile rearrangements. Molecular rearrangement involving electron deficient nitrogen – Beckmann, Hoffmann, Lossen, Schmidt and Curtius rearrangements.

**Recommended Books**:


1) "*Organic Chemistry*", R.T.Morison and R.N.Boyd, Allyn & Bacon Inc., (printed in Singapore) (2001).
2) "*Advanced Organic Chemistry*", Jerry March, John Wiley & Sons, New York, London. (2001).
3) "*Heterocyclic Chemistry"* ,T.Gilchrist.
4) "*Heterocyclic Chemistry"* , Raj K.Bansal
5) "*Introduction to Heterocyclic Chemistry*" , R.M. Acheson.
6) Molecular Rearrangements by Jack Lee, Wiley Publications
7) "*University Chemistry*", Vols II & III ,C.P.Murthy, S.F.Mehidi Ali and P.K. Dubey, New Age International (P) Ltd., New Delhi, Hyderabad **(**1996).
8) "Organic Chemistry", Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt.Ltd., Delhi (2001).
9) "*Organic Chemistry*" , Francis A Carey, Tata Mc Graw Hill, New Delhi, 7th Edition.
10) "*Fundamentals of Organic Chemistry*" , Mc Murry and Simanek, Cenagage Learning India Pvt. Ltd., New Delhi, 6th Edition.
11) "*Essentials of Organic Chemistry*" , P. Y. Bruice & K. J. Rajendra Prasad, Pearson Education, New Delhi, 2nd Edition, 2008.
12) "*Organic Chemistry*" , B. Mehta & M. Mehta, Prentice Hall of India Pvt. Ltd., New Delhi, 3rd Edition.
13) "*A Text Book of Organic Chemistry*" ,Arun Bhal & B.S. Bhal, S. Chand Pvt. Ltd., New Delhi, Revised Edition, 2008.
14)."*Heterocyclic Chemistry"* , J.A.Joule, K.Mills and G.F.Smith.

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year II-Sem (Organic Chemistry)** **L T P C**
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### Elective-1 : ANALYTICAL CHEMISTRY (OCY 15 204)

**Objectives:**
1) To understand the basic principles of analytical methods and electro analytical methods.
2) X –ray diffraction studies and TGA,DTA analysis helps the student to analyse organic and inorganic compounds.

**Unit-1: UV-Visible Spectroscopy:**
Introduction; Basic concepts; Absorption Laws – Beer's Law and its significance, Electronic energy levels; Electronic transitions; Effects of conjugation ; Effetcs of solvents ; Steric hindrance and Coplanatiry; Concepts of Chromophores ;Auxochromes; Wood-Ward – Fieser rules for calculating absorption maxima in dienes; α, β-unsaturated carbonyl compounds. Instrumentation – UV Visible Spectrophotometer; General applications of UV-absorption Spectroscopy ; Applications to Organic Compounds; Estimation of Ligand-metal rations in Complex compounds by Job's continuous variation and mole-ratio methods.

**Unit-2**: **Atomic Absorption & Emission Spectroscopy:**
Introduction to AAS; Principle; Differences between atomic absorption and flame Emission Spectroscopy; Grotrian diagram for sodium metal, Instrumentation ; Hallow cathode lamp, Atomizers, monochromator, detectors; Operation of AAS; Interferences – Spectral, Chemical, ionization, solvent interferences, Applications – Quantitative analysis, Qualitative analysis, Detection of non-metals. Introduction to AES; Theory, Types of Emission Spectra; Instrumentation ; Excitation source – flames, Dc-arc, ac-arc, ac-spark, electrodes, monochromator, detectors ; Applications – Qualitative analysis, Quantitative analysis, Inductively coupled Plasma Emission Spectroscopy – Direct Current Plasma, Inductively Coupled Plasma, ICP instrumentation.

**Unit-3**: **Chromatographic Techniques:**
Introduction; Principle of Gas Chromatographic Separations; Instrumentation - sample injection, carrier gas, columns, detectors, RF Value; Applications of GC- Qualitative analysis; Quantitative analysis. Introduction to HPLC; Principle; Apparatus for HPLC; Solvents delivery system, Pumps, Sample Injection System, Column, Packing of columns; Advantages of HPLC. Applications of HPLC – In Inorganic Chemistry, Pharmaceutical Industry, Pollution Analysis, Pesticides etc.

**Unit-4: Thermal Analysis**
Introduction – Types of thermo gravimetric analysis- Principle and method – Instrumentation – Derivative thermo gravimetric analysis – Applications. Differential thermal analysis – Principle of working – Simultaneous DTA- TGA curves- Factors effecting results – Applications – Thermometric titrations – Applications

**Unit-5: Electron Spin Resonance Spectroscopy, SEM & X-RD Studies**
Introduction; Theory of ESR; Instrumentation ; Presentation of ESR Spectrum; Hyperfine Splitting ; Applications ; Study of free-radicals, Structure determination , Analytical applications. Introduction to SEM & X-RD studies.

**Outcomes:** The student will gain a thorough knowledge of U.V visible AAS, GC,HPLC, X R D, TGA, DTA Techniques and spectroscopic principles.

**Recommended Books:**

1. "*Vogel's Text Book of Quantitative Chemical Analysis*", J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, Pearson Education Pvt. Ltd., New Delhi, (2002).
2. "*Instrumental Methods of Chemical Analysis*", G.Chatwal & S.Anand, Himalaya Publishing House, New Delhi, (2000).
3. "*Instrumental Methods of Chemical Analysis*", B.K. Sharma, Goel Publishing House, Meerut, (1998).
4. "*Organic Analytical Chemistry*", Jag Mohan, Narosa Publishing House Pvt. Ltd., New Delhi, (2003).
5. "*Analytical Chemistry – Problems & Solutions*", S.M.Khopkar, New Age International Pvt. Ltd., New Delhi, (2002).
6. "*Analytical Chemistry*" , G.L. David Krupadanam, D. Vijaya Prasad, K.Varaprasada Rao, K.L.N Reddy and C.Sudhakar, University Press (India) Ltd., Hyderabad (2001).
7. "*Applications of Absorption Spectroscopy of Organic Compounds*" , John R.Dyer, Prentice-Hall of India Pvt. Ltd., New Delhi (1969).
8. "*Molecular Spectroscopy- Principles and Chemical Apllications*" , P.R. Singh and S.K. Dikshit, S. Chand & Co., New Delhi (1988).
9). "*Analytical Chemistry*" , Gurdeep R. Chatwal, Himalaya Publishing House Pvt. Ltd., New Delhi.

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### Elective-2 : SOFT SKILLS DEVELOPMENT & PRACTICE (OCY 15 204)

**Objectives:**

To improve the fluency of students in English
To facilitate learning through interaction
To illustrate the role of skills in real-life situations with case studies, role plays etc.
To train students in group dynamics, body language and various other activities which boost their confidence levels and help in their overall personality development
To encourage students develop behavioral skills and personal management skills
To impart training for empowerment, hereby preparing students to become successful professionals.

Unit-1: Introduction : Definition and introduction to soft skills- Hard Skills Vs Soft Skills – Significance of Soft/Life/Self Skills – Self and SWOT Analysis and

1. **Exercises on Productivity Development**
   Effective / Assertive Communication Skills ( Activity based)
   Time Management ( Case study)
   Creativity & Critical thinking (Case study)
   Decision making and problem solving ( Case study)
   Stress Management ( Case study)

2**. Exercises on Personality Development Skills**
   Self-esteem (Case study)
   Positive Thinking ( Case study)
   Emotional intelligence ( Case Study)
   Team building and leadership skills ( Case study)
   Conflict Management ( Case study)

3. **Exercises on Presentation Skills**
   Netiquette
   Importance of oral presentation – Defining purpose – Analyzing the audience – Planning outline and preparing the presentation – Individual & group presentation – Graphical organizers – Tools and multi-media visuals.
   One Minute presentations ( Warming up)
   PPT on Project work – Understanding the Nuances of Delivery – Body language- Closing and handling questions -Rubrics for individual evaluation ( Practice sessions)

4. **Exercises on professional Etiquette and Communication**
   Role –play and simulation – Introduction oneself and others, Greetings, Apologies, requests, Agreement & Disagreement etc.
   Terlephone etiquette
   Active listening
   Group discussions ( Case study) – Group discussion s a part of selection procedure – Checklist of GDs
   Analysis of selected interviews ( Objectives of interview)
   Mock-Interviews ( Practice sessions)
Job Application and preparing resume

Process writing ( Technical vocabulary) – Writing a project Report – Assignments

**5.Exercises on Ethics and values**:
Introduction – Types of values – Personal, social and cultural values – Importance of values in various contexts.
Significance of Modern and Professional Etiquette – Etiquette ( Formal and informal situations with examples)
Attitude, good manners and work culture ( Live examples)
Social Skills _ Dealing with the challenged ( Live examples)
Professional Responsibility – Adaptability ( Live examples)
Corporate expectations

**Outcomes:**
Developed critical acumen and creative ability besides making them industry ready.
Appropriate use of English language while clearly articulating ideas
Developing insights into language and enrich the professional competence of the students
Enable students to meet challenges in job and career advancement.

**Reference Books:**

1. Alex, K.2012. Soft ASkills. S.Chand Publishers
2. Management Shapers 2011. Collection of 28 books by different Authors. Universities press.
3. Sherfield, Robert M.2005.et al Xornerstone: Development Soft Skills. Pearson
4. Suresh Kumar,E; Sreehari, P.& Savithri, J.2011. Communication skills and soft skills – An Integrated Approach. New Delhi: Pearson
5. The ACE of soft skills by Gopalaswamy Ramesh & Mahadevan Ramesh, 2013. Pearson Publishers . New Delhi.
6.Patnaik, P.2011. Group Discussin and Inerview skills, New Delhi: Foundation
7.Sudhir Andrews.2009. How to succeed at interviews. New Delhi: Tata McGraw Hill
8.Sasikumar, V & Dhamija, P.V. 1993. Spoken English – A self learning guide to Conversation practice. New Delhi: Tata McGraw –Hill
9. Dixson, Richard J. Everyday Dialogues in English. Prentice Hall India Pvt. Ltd.
10. Mukhopadhyay. L et al. 2012. Polyskills, New Delhi: CUP India Pvt Ltd.
11. Rizvi, M.A. 2005. Effective Technical Communication, New Delhi. Tata McGraw Hill
12. The Hindu Speaks on Education by the Hindu Newspaper
13. Naterop, B.Jean and Revell, Rod. 2004. Telephoning in English. Cambridge: CUP

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. I Year II-Sem (Organic Chemistry)**

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### PHYSICAL CHEMISTRY LABORATORY – II (OCY 15 L21)

**I) Conductometry:**

a) Conductometric titrations of strong acid Vs weak base.
b) Conductometric titrations of weak acid Vs strong base.
c) Conductometric titrations of mixture of acids (HCl+ AcOH) Vs strong base.
d) Conductometric titrations of strong acid (HCl) Vs weak base ($NaHCO_3$).
e) Kohlrausch's law - verification.
f) Onsager's equation - verification.

**II) Potentiometry & $P^H$ Metry:**

a) Titration of strong acid Vs strong base.
b) Titration of mixture of acids (HCl + AcOH) Vs strong base
c) Titration of weak acid Vs strong base.

**III) Nephelometric Determinations:**

a)Sulphate
b)Phosphate

iv) Determination of Physical constants:
a) Viscosity measurement by Redwood viscometer
b) flash and fire point measurement by Pensky Martens apparatus
c) surface tension by Stalagmometer.

**Recommended Books**:

1. "*Senior Practical Physical Chemistry*" , B.D.Khosla, 6th edition V.C.Garg and A.Khosla, R.Chand & Co., Delhi (1991).
2. "*Practical Physical Chemistry*", J.B.Yadav, 5th edition Krishna Prakash media Pvt Ltd, Meerut (1997).
3. "*Practical Physical Chemistry*", B.Viswanathan, P.S.Raghavan, 1st edition Viva Books Pvt. Ltd (2005).
4. "*Experiments in Physical Chemistry*" ,David P. Shoemaker, Carl W. Garland and Joseph W. Nibler, 5th edition Mc Graw-Hill Book Company (1989).

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**M.Sc. I Year II-Sem (Organic Chemistry)**

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### INORGANIC CHEMISTRY LABORATORY – II (OCY 15 L22)

**I) GRAVIMETRIC ANALYSIS**

a) Estimation of Nickel as DMG complex.
b) Estimation of Barium as Sulphate.

**II) ANALYSIS OF INORGANIC MATERIALS**

a) Manganese in Pyrolusite.
b) Cycle of Copper Reactions.
c) Iron in Iron ore.
d) Percentage purity of Lime stone.

**III) ANALYSIS OF TWO COMPONENT MIXTURES**

a) Determination of Al(III) & Fe(III)
b) Determination of Cu(II) and Zn(II)
c) Determination of Cu(II) and Ni(II)
d) Determination of Ferrocyanide and ferricyanide

**IV) PREPARATIONS OF METAL COMPLEXES**

a) $[Mn(acac)_3]$
b) $[Co(NH_3)_5Cl]Cl_2$
c) $[Ni(en)_3]S_2O_3$
d) $[Ni(NH_3)_6]Cl_2$
e) $[Cu(NH_3)_4]SO_4$
f) $Hg[Co(SCN)_4]$

**Recommended Books:**

1) "*Text book of Quantitative Chemical Analysis*", Vogel's -
2) "*Advanced Inorganic Analysis*", Dr. S.C. Rastogi, S.K. Agarwal & Keemti Lal.
3) "*Analytical Chemistyr*", S.M. Khopkar.
4) "*Modern Experiments for Introductory Chemistry* ", H.A. Neidig & W.J. Stratton.
5) "*A hand book of Analytical Chemistry* "Vol-2 , Dr. S.C. Rastogi & S.K. Agarwal.

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**M.Sc. I Year II-Sem (Organic Chemistry)**

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## ORGANIC CHEMISTRY LABORATORY - II (OCY 15 L23)

**1. Qualitative Analysis:**

Analysis of at least six binary mixtures of monofunctional organic compounds by using systematic qualitative analyses technique. The following types of mixtures may be used.

a) Solid – Solid
b) Solid – Liquid.
c) Liquid – Liquid.

**2. Quantitative Analysis:**

a) Estimation of Phenols
b) Estimation of Aniline
c) Estimation of Amino Acids.
e) Estimation of Glucose by Fehling's solution.

**Recommended Books:**

1. "*A Textbook of Practical Organic Chemistry*: *Quantitative and Qualitative analysis*", Vogel.
2. "*Practical Organic Chemistry*", Mann and Saunders.
3. "*Laboratory Organic Manual*", R.K.Bansal.
4). "*Comprehensive Practical Organic Chemistry*" , V.K.Ahilwalia & Renu Aggarwal, Universties Press (India) Pvt. Ltd., New Delhi.

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. II Year I-Sem (Organic Chemistry)**

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## BIO ORGANIC CHEMISTRY (OCY 15 301)

**Objectives:** The student of this course has to acquire a knowledge of chemistry involved in biological system. He should learn the enzymes, kinetics of enzyme action, and application of enzymes in organic synthesis.

**Unit 1: Basics of Bioorganic Chemistry**
Introduction to Bioorganic Chemistry- basic consideration -proximity effects in Organic Chemistry, molecular adaptation, molecular recognition and the supramolecular level

**Unit 2: Enzymes**
Introduction to enzymes- classifications of enzymes -mechanism of enzyme action.
Characteristics of enzyme catalysis – Factors affecting the rate of enzyme reaction- Concept of active site and energies of enzyme- substrate complex formation, specificity of enzyme action. Michealis-Menten's mechanism.

**Unit 3: Enzyme Kinetics - I**
Kinetics of enzyme action – Allosteric regulation of enzymes –method changes Wyman model, pH and temperature effects of enzymes and derivation, Kinetics – stereo specific enzyme magnetic reactions – Stereochemistry of nucleophilic reactions – Chiral methyl group – chiral phosphate.

**Unit 4: Enzyme Kinetics - II**
Enzyme immobilization and case studies of enzyme structure and mechanism. Physical and chemical techniques for enzyme immobilization absorption, matrix entrapment, encapsulation, cross linking, covalent bonding etc., examples, advantages and disadvantages. Case studies include dehyderogenase, proteases-cyto enzyme, stability of proteins.

**Unit 5: Enzymes in organic synthesis**
Utility of enzymes in organic synthesis with the study of various examples – multifunctional catalysis and simple models, α- chyrotripsin tetrahydral intermediates. Guest-host chemistry involving Cylodextrins, calyx(n) arenes, Crown ethers, enantio selective molecular recognition, molecular self assembly.

**Outcomes:** The student will learn about enzyme catalysis, kinetics of enzyme action. The stereo chemical aspects of chemical reactions catalysed by enzymes are learnt.

**Recommended books:**

1.Harvey W. Blanch, Douglas S.Clark " Biochemical Engineering; " Marcel Dekker, Inc.
2.James M.Lee " Bio Chemical Engineering; PHI, USA.
3. Bio Organic Chemistry; H. Dugas, Springer Verlag, 1999.
4. James E. Bailey and David F. Olis " Bio Chemical Engineering Fundamentals.
5.Stereo Chemistry of Organic Compounds ( D. Nasipuri, 2nd edition New Age international.
7.Text Book of Bio chemistry O.P.Agarwal Publishing house, Meerut(1999).

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. II Year I-Sem (Organic Chemistry)**

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## CHEMISTRY OF SYNTHETIC REAGENTS & PATENT RIGHTS (OCY 15 302)

**Objectives:** The knowledge of oxidizing and reducing reagents is required for the student. He should know the requirements and procedures for filing the patents, which is very important.

**Unit - 1: Oxidizing Agents & Dehydrogenating Agents:**
Chromium based reagents used in Organic Synthesis – Chromium (VI) Oxidizing agents like Potassium dichromate, Chromium trioxide, Pyridinium Chlorochromate, Pyridinium dichromate. Magnese reagents - $KMnO_4$, Manganese dioxide; silver carbonate on celite; hydrogen peroxide, m-chloroperbenzoic acid, peroxyacetic acid and nitric acid. Chloranil, DDQ, Lead Tetraacetate, Cupric acetate, Ceric ammoniumnitrate used in Organic Synthesis. Reagents based on hypervalent iodine-Trivalent, Penta valent.

**Unit - 2: Reducing Agents:**
Sodium in alcohol; $H_2$ over Catalysts (heterogeneous and homogeneous);Raney Ni Magnesium in alcohol. Sodium borohydride, Lithium aluminiumhydride, sodium cyanoborohydride, Sodium triacetoxy borohydride.Zn-Hg in HCl

**Unit - 3: New Synthetic Reagents & Named Reactions :**
Hydroboration with Simple borane and Substituted Boranes; Disamylboranes, Thexylboranes, 9-Borabicyclo(3,3,1)Nonane(9-BBN); Reactions of Chiral Organoboranes. Wittig olefination , Julia reaction; Stork enamine reaction.

**Unit - 4: Use of Organometallic Reagents:**
C-C bond formation using Grignard reagents; alkyl and aryl lithium, Organo-copper reagents; Palladium in organic synthesis; Stille , Negeshi Suzuki & Heck Coupling reactions. Grubbs' Metathesis reactions- Olefin metathesis. Miyayura reactions, Mitsinobu reaction. C-N Bond formation

**Unit - 5: Intellectual Property Rights & Patents:**
Intellectual Property in Drug Discovery; Introduction to Patents, copy right; GIs, Patents in the wider context of intellectual property rights; What can be Patented, requirements for patentability, patent restrictions, how are patents obtained; The Power of Patents. Introduction to Patent Medicine; Role of patents in R & D.

**Outcomes:** A thorough knowledge of oxidizing and reducing agents in chemical synthesis and detailed principles, procedures and requirements for filing patents is gained from this paper.

**Books Recommended:**

1. "*Reagents for Organic Synthesis*" , Fieser and Fieser.
2. "*Synthetic Reagents*" Vols. I and II , Pizey.
3. "*Organic Synthesis – Special Techniques*" , V.K. Ahluwalia & Renu Aggarwal, Narosa Publishing House, New Delhi (2001).
4. "*Reactions, Rearrangements and Reagents*" , S.N. Sanyal, Bharati Bhawan, Publishers, Patna (2002).
5. "*Organic Reaction Mechanisms*" , V.K. Ahluwalia & R. K. Parashar, Narosa

Publishing House, New Delhi (2002).
6. "*What everyone should know about Patents*", N. Subbaram, Pharma Book Syndicate, Hyderabad (2003).
7. "*Name reactions*" , K. Jack Lee
8."*Organic Synthesis*", Curruthers Ritchard.
9. "Organic Synthesis", Carrey & Sund Berg Vol. I, Vol.II.
10. "Organic Synthesis", Michael B.Smith

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. II Year I-Sem (Organic Chemistry)** **L T P C**
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## ORGANIC SPECTROSCOPY (OCY 15 303)

**Objectives:** The spectroscopy is very important concept for the determination of structures of organic molecules. The basic principles of various types of spectroscopy viz., IR, NMR, Mass and their applications are to be learnt by the student.

**Unit 1: Infra Red Spectroscopy**:
Degrees of freedom for the energy of a molecule; Molecular Vibration – Types of molecular vibration; Mechanics of measurement of IR Spectra; Block Diagram of the IR Spectrometer; Sampling techniques; Factors influencing IR absorption peaks; Fermi Resonance, Coupling Interaction, Hydrogen bonding etc; Interpretation and applications of IR Spectra.

**Unit 2: Nuclear Magnetic Resonance Spectroscopy – I:**
Principles of NMR Spectroscopy; Characteristics of a PMR Spectrum; Number of signals; Chemical shift - Ring current effects Aromaticity, Diamagnetic Anisotropic effects; Integration, Spin-Spin coupling. Mechanics of Measurement; Instrumentation for Continuous wave PMR; Solvents used; Reference standards such as TMS, DSS etc.

**Unit 3: Nuclear Magnetic Resonance Spectroscopy – II:**
Coupling constants; Karplus Equation; Vicinal, geminal, vinylic and aromatic protons. Nuclear Magnetic Resonance – A closer look; Larmor's Precessional Motion; Spin - Spin and spin-lattice Relaxations; Population of Nuclear spins; Protons bound to heteroatoms; Protons bound to Oxygen – Effect of hydrogen bonding & chemical exchange; Spectrum of ethanol; Protons bound to Nitrogen; Effect of nuclear quadrupole moment; $D_2O$ exchange process; Hindered rotation; Spectrum of Dimethyl formamide.

**Unit 4: Advanced Nuclear Magnetic Resonance Spectroscopy:**
Simplification of PMR spectrum; Higher Resolution NMR; Double Resonance technique; Lanthanide shift reagents. $^{13}C$ NMR Spectroscopy; CW & FT methods; Proton Noise Decoupled and Off-Resonance Spectra; 2D – NMR spectroscopy; NOESY & COESY Techniques.

**Unit 5: Mass Spectrometry:**
Basic principles; Instrumentation– The electron –impact mass spectrometer; GC-MS and Double Focussing instruments; Nitrogen rule, Types of ions in the mass spectrometer – Mass spectral fragmentation patterns of some select class of organic compounds such as hydrocarbons, alcohols, acids etc. - Mc Lafferty rearrangement, Methods of ionizations EI, CI, Fast Atom Bombardment (FAB), Secondary Ion Mass Spectrometry (SIMS), Electrospray (ESI) ionization and Matrix Assisted Laser Desorption Ionization (MALDI) methods. Gas Chromatography-Mass Spectrometry (GC-MS) and Liquid chromatography-Mass Spectrometry (LC-MS) techniques- Applications.

**Outcomes:** The student will learn the principle involved in IT,NMR and Mass spectroscopic techniques in finding out the structures of organic compounds. The latest techniques like NOESY, COESY and advanced instrumentation like MALDI, GC-MS, LC-MS are learnt.

**Recommended Books:**

1. "*Spectrometric Identification of Organic Compounds"* ,R.M. Silverstein, G.C. Bassler and T.C.Morill, John Wiley & Sons, New York (1981).
2. "*$^{13}$C – NMR Spectroscopy"*, Abraham and Lofthus, Heydon & Sons Ltd., Philadelphia (USA) (1979).
3. "*Spectrometric Methods in Organic Chemistry*" , Dudley H.Williams and Ian Flemming, Tata Mc Graw-Hill Publishing Company Limited, New Delhi (1990).
4. "*Spectroscopy*", P.S.Kalsi, Wiley Eastern Ltd., New Delhi, Hyd., (1998).
5. "*Spectroscopy"*, Jag Mohan, Narosa Publishing House, New Delhi (2000).
6. "*Nuclear Magnetic Resonance Spectroscopy*",Mala Datta, Sarup & Sons, New Delhi (2000).
7) "*Spectroscopy"* by William Kemp.
8) "*Spectroscopy*", Pavia, Lampman , Kriz & Vyvyan, Cenegage Learning India Pvt.Ltd., New Delhi (2008).
9) "*Molecular Spectroscopy - Principles and Chemical Applications*" , P.R. Singh and S.K.Dikshit, S.Chand & Co., New Delhi (1988).
10) "*Mass Spectroscopy*", Howe, Williams and Brown, Tata Mc Graw-Hill Publishing Company Limited, New Delhi (1990).
11) "*Organic Structures from Spectra*" , L.D. Field, S.Sternhell and J.R.Kalman, John Wiley & Sons, New York (2002).
12). "*Nuclear Magnetic Resonance- Basic Principal* " ,Atta–ur- Rahman, Spinger(India) Pvt. Ltd., New Delhi (2008).
13). "*Molecular Structure and Spectroscopy*", G. Aruldhas, Eastern Economy Edition, 2nd Edition, New Delhi(2008).
14). "*Introduction to Magnetic Resonance Spectroscopy ESR, NMR, NQR*", D.N. Sathyanarayana, I.K.Internataional Publshing House Pvt. Ltd., New Delhi(2009).
15). "*Fundamentals of Atomic & Molecular Spectroscopy*", Ramphal Sharma,Himalaya Publishing House Ltd., 1st Edition, New Delhi (2008).

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. II Year I-Sem (Organic Chemistry)**

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### Elective-1 : CHEMISTRY OF POLYMERS (OCY 15 304)

**Objectives:** Polymers have associated with humans in every half of life. The synthesis, properties and applications of the plastics are very essential for a postgraduate student of chemistry. He should also learn the biodegradation of them in soil.

**Unit -1**: **Organic Polymers:**
Definition and Classification; Principles of Polymerization; Chain polymerization - Free radical, Anionic and Cationic types; Co-ordination polymerization – Zeigler Natta Catalysts; Miscellaneous polymerizations; Inhibitors; Step growth polymerization; Types of polymers based on structural types and Tacticity.

**Unit -2**: **Plastics:**
Definition and classification: Thermoplastic materials; Preparation, properties and uses of Polyethylenes, Teflon, Polyvinyl acetate, Polyvinylchloride, Polystyrene and Polymethyl methacrylate. Preparation, Properties and uses of Theromoset plastics such as Phenol-Formaldehyde resins, Urea-Formaldehyde resins, Melamine-Formaldehyde resins. Alkyl resins, Epoxy resins, Polyurethanes etc; Compounding of plastics and Fabrication techniques.

**Unit- 3**: **Elastomers & Chemical Fibers:**
Natural rubber; Its structure and Processing; Synthetic rubbers – Thiokol, Neoprene, Buna-S, Buna-N etc. – Their methods of preparation, properties and uses; Compounding and vulcanization of rubber. Classification and properties of fibers; Natural fibers like Cotton, Wool, and Silk; semi- synthetic fibres - Preparation, properties and uses of Cuprammonium rayon, Acetate rayon, Viscose rayon; Preparation, properties and uses of Synthetic fibers – Nylon, Kevular, Polyethyleneterephthalate, Polyacrylonitrile, Vinyon.

**Unit -4**: **Physical Chemistry of Polymers:**
Molecular weight and Size; Number Average and Weight Average molecular weights; Significance; Experimental methods for the determination of average molecular weights of polymers by Viscometry, Osmometry, Ebulloscopy, Cryoscopy, Sedimentation and Light scattering methods. Degree of Polymerization; Polydispersity and molecular weight distribution in polymers; Practical significance of polymer molecular weight; Glass transition temperature - Its determination and significance.

**Unit- 5**: **Inorganic polymers** :
General Survey of Inorganic Polymers; Preparation, Properties and uses of Polyphosphazenes, Poly(Siloxanes), Elemento- organic polymers – Silicones; Boom Polymers.

**Outcomes:** The student will learn the preparative procedures, properties and applications of the various polymers and rubbers. He will also get good knowledge of biodegradable polymers.

**Recommended Books:**

1. "*Polymer Science*" , V.R. Gowrikar, N.V. Viswanathan and J. Sreedhar, Wiley Eastern Ltd., New Delhi, Hyderabad. (1988).

2. "*Introductory Polymer Chemistry*" ,G.S.Misra, New Age International Pvt. Ltd., Hyderabad. (1996).
3. "*Synthetic Drugs and Polymers*", D. Dasharath, Sri Vani Publishers Mumbai (2002).
4. "*Text Book of Polymer Science*", F.W. Billimeyer.
5. "*Polymer Chemistry*" , P.J. Flory.
6. "*Organic Polymer Chemistry*", K.L. Saunders.
7. "*Engineering Chemistry*", 15th Edition, P. C. Jain and Monika Jain, Dhanpat Rai Publishing Company, New Delhi (2005).
8. "*A Text Book of Polymers Vols. I, II & III*", M.S. Bhatnagar, S. Chand & Co., New Delhi.

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### Elective-2 : CHEMISTRY OF PESTICIDES (OCY 15 304)

**Objectives**: Pesticide industry is developing in India is recent times. The chemists with the knowledge of pesticides are highly needed in our country. The student will be trained on the chemistry of pesticides, their manufacturing, biofertilizers etc.

**Unit-I: Introduction** – Classification – History of pesticides, innovation of pesticides chemistry, development of pesticides.

**Unit-II: Chemistry of Pesticides:** Brief introduction to classes of pesticides, structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, mode of action, uses, toxicity (acute and chronic toxicity in mammals, birds, aquatic species etc.,), methods of analysis.

**Unit-III: Manufacturing process of some pesticides**: Lindane (BHC), DDT, Parathion, Phorate.

**Unit-IV: Biofertilizers** : Introduction, definition, classification, Rhizobium, Azatobactor, Azospirillium, Azolla, Blue Green Algae, VAM, Vermicomposting.

**Unit-V: Recent advances in Pest control**: **Green Chemistry in pesticides:**
Recent insect attractants, Chemosterilants and Repellents, Mode of action and Applications of Neem in plant protection: Introduction, Chemical constituents, Bioefficacy of neem preparation.

**Outcomes:** The students gets a good knowledge on the pesticide chemistry, then analysis, manufacturing, biofertilizers. He also learns on the pest control by using herbal preparation in order to present the environment.

**Recommended Books:**


1. *"Chemistry of Insecticides and Fungicides"* , U.S. Shree Ramulu, Oxford & IBH Publications, 2nd Edition, 1995.
2. *"Pesticide Synthesis"* – P.S. Marg, G. K. Kohn, J. J. Menn.
3. *"Analyitcal methods for Pesticides, Plant Regulators & Food Additives"*, Vol 1, Ed. By Gunter Zweig.
4. *"outlines of Chemical Technology"*, C. E. Dryden, Ed. By Agrobios (India).
5. *"Pesticides: Preparation and mode of action"* , Cremlyn Dekker.

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### Extraction of Natural Products & Preparation of Polymers Lab (OCY 15 L31)

1) Extraction of Caffeine from tea leaves.
2) Extraction of nicotine from Tobacco.
3) Extraction of lycopene from tomatoes.
4) Extraction of Piperine from Pepper.
5) Extraction of Cucurmine from turmeric powder.
6) Extraction of casein from milk.

1) Preparation of Bakelite
2) Preparation of urea-formaldehyde resin
3) Preparation of Nylon 6:6
4) Preparation of Thiokol Rubber

**Recommended books:**

1. *"Vogel's qualitative and quantitative Organic Analysis".*
2. *"Laboratory Manual of Polymers"*, S,M. Ashroaf, Shareef Ahmed, Riaz, I. K. International Publications.
3. *"Engineering Chemistry Laboratory Experiments"*, M. S. Kaurav. PHI Publications.
4. *"Polymer Synthesis and Characterization: A Labortatory Manual"*, Stanley Robert, Academic Press.

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## INSTRUMENTAL METHODS OF ANALYSIS & COMPUTATIONAL CHEMISTRY LABORATORY (OCY 15 L32)

**1) Thin Layer Chromatography and Paper Chromotography:**

a) Determination of the purity (no. of compounds present) of a given sample by thin layer chromatography (TLC).
b) Monitoring the progress of chemical reactions by thin layer chromatography (TLC).
c) Introduction & demonstration of Paper chromatography.

**2) UV-Visible Spectroscopy**:

Recording and analysis of the following compounds:-
a) Aq. $KMnO_4$ b) Aq. Potassium dichromate c) Benzoquinone d) Any one azo-dye

**3) Infrared Spectroscopy:**

Recording and Study of KBr phase IR spectra of the following compounds:-
a) Benzoic acid b) Acetanilide c) β- naphthol d) Benzophenone e) p-Nitroaniline
f) Cinnamic acid.

.**4) Computational Chemistry:**

a) Introduction to computers – DOS and LINUX [Basics]
b) HTML
c) Creating Database – Creation of tables and Insertion of rows using MYSQL ( Ligand Database), Chemical Databases ,SQL and Oracle
d) Searching Database (Online)
e) Visualizing molecules using different softwares [ RASMOL, Swiss PDB Viewer]
f) Conformational analysis of small molecules [Ethane]
g) Building Molecules and Energy minimization.
h) Data Processing and Curve fitting by MS- Exel.
i) Study of molecules using chemoffice.

**5) Column Chromatography:**

Separation of Organic Compounds *o*- and *p*-nitroanilines.

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## MULTI-STEP SYNTHESES LABORATORY (OCY 15 L33)

a) Preparation of p-bromoaniline using the sequence of reactions (protecting and deprotecting)
Aniline ⟶ Acetanilide ⟶ p-Bromoacetanilide ⟶ p-Bromoaniline

b) Preparation of 1-methyl-2-styrylbenzimidazole using the sequence of reactions. (using phase transfer catalytic method)
OPDA ⟶ 2-Methylbenzimidazole ⟶ 2-Styrylbenzimidazole ⟶ 1-Methyl-2-Styrylbenzimidazole

c) Preparation of N- methyl-2-phenylindole using the sequence of reactions given below
Aniline ⟶ Phenylhydrazine ⟶ Phenylhydrazone ⟶ 2-Phenylindole ⟶ N-Methyl-2-phenylindole

d) Preparation of benzilic acid using the sequence (Molecular Rearrangement)
Benzoin ⟶ Benzil ⟶ Benzilic acid

e) Preparation of Benzopinacolone using the sequence (Photochemical Reaction)
Benzophenone ⟶ Benzpinacol ⟶ Benzpinacolone

**Books Recommended (For OCY 15 L32 & OCY 15 L33)**

1. "*Spectrometric Identification of Organic Compounds",* R.M. Silverstein, G.C. Bassler and T.C. Morill, John Wiley & Sons, New York (1981).
2. "*Organic Structures from Spectra*" , L.D. Field, S.Sternhell and J.R. Kalman, John Wiley & Sons, New York (2002).
3. "Chromatography" , B.K. Sharma.
4. "*A Textbook of Practical Organic Chemistry*: *Quantitative and Qualitative analysis*" , Vogel.
5. "*Practical Organic Chemistry*" , Mann and Saunders.
6. "*Laboratory Organic Manual*" , R.K. Bansal.

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**M.Sc. II Year II-Sem (Organic Chemistry)**

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## ORGANIC SYNTHESIS (OCY 15 401)

**Objectives:** The student should acquire a sound knowledge of retrosynthesis, protecting groups ad stereochemical aspects of asymmetric synthesis to perform the organic synthesis.

**Unit-1: Synthetic Strategies – I:**
Introduction to Organic Synthesis; Target selection; The Disconnection Approach with Examples; Terminology, Definition of Target Molecule, Functional Group Interconversion(FGI), Disconnection Product – Disconnection, Synthon Reagents, Transforms and Retrosynthesis; Chemoselectivity; Regioselectivity and Stereoselectivity

**Unit-2: Synthetic Strategies-II: Tree- Linear and Convergent Synthesis:** Importance of Order of Events in Organic Synthesis – Examples; One Group C-X and Two Group C-X disconnections – Examples; Synthesis Reversal of Polarity Synthesis ( – Cyclisation reactions and Amine Synthesis; Introduction to One Group C-C, C- heteroatom. Disconnctions and Two Group Disconnections – Examples; Strategic bonds – Definition; Criteria for Disconnection of Strategic Bonds in Carbocyclic and heterocyclic rings.

**Unit-3: Protective Groups in Organic Synthesis:**
Protection of Alcohols as ether groups and as ester groups; Protection of Diols as acetal,ketals
and as carbonates; Protection of carboxylic acids by acetylation, benzylation, benzoxycarbo nylati-on and by triphenyl methyl groups; Protection of carbonyl groups by acetal, ketal and dithioglycol formation.

**Unit-4: Asymmetric Synthesis – I:**
Methods for Inducing Stereo Selectivity in reactions; Methods of Asymmetric Synthesis; Classification into Substrate Auxiliary, Reagents and Catalyst Controlled Synthesis. Definition of Enantiomeric Excess and Diastereomeric Excess; Substrate Controlled Asymmetric Synthesis; Asymmetric Induction – Examples. 1,2 – Asymmetric Induction – Nucleophilic Addition to Carbonyl Groups – Cram's Rule.

**Unit-5: Asymmetric Synthesis – II:**
Auxillary Controlled Asymmetric Synthesis, α – Alkylation Reactions of Chiral Enolates; and Chiral Hydrazones; Asymmetric Diels-Alder Reaction; Asymmetric Aldol Reaction; Introduction to enzyme Mediated Asymmetric Synthesis; sharpless asymmetric epoxidation; CBS reduction Noyori -BINAP hydrogenation.

**Outcomes:** The student learns about the synthetic strategies for the disconnection of C-C, C-X bonds. He acquires enough knowledge a protective groups and substituent controlled and auxillary controlled asymmetric synthesis.

**Recommended Books:**
1). "*Some modern methods of Organic Synthesis*" , W. Carruthers.
2). "*Guidebook to Organic Synthesis*", R.K.Meckie, D.M.Smith & R.A.Atken
3). "*Organic Synthesis"*, H.House.
4). "*Organic Synthesis* ", Michael Smith.
5). "*Organic Synthesis*", Robert. E. Ireland.
6). "*Organic Synthesis – The Disconnection Approach"*, S. Warren.
7). *"Organic Synthesis"*, C. Willis and M. Willis.
8). "*Handbook of Reagents for Organic Synthesis* ", Reich and Rigby, Vol. I- IV
9). "*Problems on Organic Synthesis*", Stuart Warren.

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## PHOTOCHEMISTRY & PERICYCLIC REACTIONS (OCY 15 402)

**Objectives:**
The Principles of Photochemistry and the reactions of ketones, alkanes and aromatic compounds are to be studied. The important aspects of synthetic chemistry is the study of perycyclic reactions in which the electrocyclic, cycloadditions and sigmetropic reactions are learnt.

**Unit-1: Photo Chemistry - General:**
Introduction and importance; Energy content of a molecule; Thermal energy, Activation energy and Photochemical energy; Photochemical excitation; Experimental Techniques for doing photochemical reactions. Types of Electronic excitation and molecular orbital view of excitation; Joblonski diagram; Energy transfer; Laws of Photo chemistry; Einstein's law and Quantum yield.

**Unit-2: Photochemistry of Ketones, Alkenes and Aromatic Compounds:**
Photochemistry of Ketones; Norrish Type-I and Norrish Type-II reactions; Photo-reduction; Photochemistry of alkenes and conjugated dienes Patterno-Buchi reaction. Photochemistry of aromatic Compounds – Isomerisations, additions and substitutions; Photo - Fries rearrangement of anilides; Barton reaction; Singlet oxygen reaction.

**Unit-3: Pericyclic Reactions - General concepts :**
Wave - nature of electron – LCAO – Characteristics of bonding and anti-bonding orbitals (non-mathematical treatment only); Electronic configuration of polyenes – 1,3 - butadiene, 1,3,5 - hexatriene; Definition and Classification of Pericyclic reactions.

**Unit-4: Electrocyclic reactions:**
Electrocyclic reactions; Orbital symmetry; Thermal and Photochemical reactions of 1,3-butadiene and 1,3,5 – hexatriene; Stereochemical implications of FMO approach; Correlation diagrams for 1,3 - butadiene, 1,3,5 - hexatriene, cyclobutene and cyclohexadiene – Woodward - Hoffmann rules.

**Unit-5: Cycloaddition reactions and Sigmatropic rearrangements:**
Cycloaddition reactions – Definition and Nomenclature; (2+2) and (4+2) cycloaddition reactions – Woodward - Hoffmann rules. Sigmatropic rearrangements – Definition and Nomenclature; Hydrogen shifts; Examples of 1,3 – and 1,5 – hydrogen shifts. Cope and Claisen rearrangements – Mechanisms and evidences in support of the mechanisms.

**Outcomes:** The student will get a through knowledge of the latest and important topics of photochemical reactions of ketones, alkenes and aromatic compounds and also the types of pericyclic reactions viz., electrocyclic, cycloaddition and sigmatropic reactions. These concepts will enhance the ability and skills of a synthetic chemist.

**Recommended Books:**

1. "*Organic Chemistry*", R.T.Morison and R.N.Boyd, Allyn & Bacon Inc., (printed in Singapore) (2001).
2. "*Advanced Organic Chemistry*", Jerry March, John Wiley & Sons, New York, London. (2001).
3. "*Organic Chemistry*", Vol.I, S.M.Mukherji, S.P. Singh and H.P. Kapoor, Wiley Eastern Ltd., New Delhi, Hyderabad. (1985).
4. "*Organic Chemistry*", Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt. Ltd., Delhi (2001).
5. "*Photochemistry and Pericyclic Reactions*", Jagdamba Singh, New Age International (P) Ltd., New Delhi , Hyderabad (2003).
6. "*Molecular Reactions and Photochemistry*", Charles H. Depuy and Orville L. Chapman, Prentice Hall of India (P) Ltd., New Delhi (1988).
7). " *Organic Photochemistry*" , Gurdeep R.Chatwal, Himalaya Publishing House, New Delhi(2008).
8) "*Conservation of orbital symmetry*", Ian Fleming.
9) *"Pericyclic Reactions* ", Sankar Raman, Wiley.

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## TOTAL SYNTHESIS OF ADVANCED NATURAL PRODUCTS (OCY 15 403)

**Objectives:** A knowledge on natural products which have a variety of chemical spetres with biological activities, is required to probe the nature for the welfare of mankind. To the student to learn about Alkaloids terponoids, sterols, prostaglandins, this course is designed.

**Unit-1**: **Terpenoids:** General Introduction, Definition, classification, Isolation. Terpenoids, higher terpenoids: Di and tri terpenoids – Synthesis and chemistry of Camphor, abietic acid, β- amyrin, β- carotene.

**Unit- 2: Alkaloids :**
General Introduction, Definition, classification, Isolation, Purification and general methods of structure determination; Hoffmann, Emde and Von Brown degradations; Herzig & Meyers methods etc.; Morphine Alkaloids**:** Structure, Stereochemistry and Synthesis of Morphine, Codeine and Thebaine; Structure – Activity studies on Morphine and its derivatives like Heroin.

**Unit-3: Sterols :** Structure determination and Total synthesis of cholesterol, progesterone, testosterone, androsterone.

**Unit-4: Chemistry of biosynthesis**
Biosynthesis of Carbohydrates, terpenoids, steroids, corticoids and alkaloids.

**Unit-5: Prostaglandins:**
Occurrence**,** isolation, clinical significance & structure and synthesis of $PGE_1$, $PGE_2$ and $PGE_3$.

**Outcomes:** The student will learn the total synthesis of terpenoids, alkaloids, sterols and prostaglandins. He also get enough knowledge on the biosynthesis of natural products like carbohydrates, steroids, corticoids and alkaloids.

**Recommended Books:**
1. "*Organic Chemistry*", Vol-2, by I.L.Finar, ELBS – London.
2. "*Chemistry of Alkaloids*", by S.Pelletier, Van Nostrand Company.
3. "*Natural Products and Alkaloids*", by K.W.Betley.
4. "*Chemistry of terpenes*", by Simonsen, Revised by Sukh Dev.
5. "*Chemistry of Steroids*", by Fieser and Fieser.
6). "*Organic Chemistry of Natural Products*" by Gurdeep R.Chatwal, Himalaya Publishing House Ltd., New Delhi (2008).

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### Elective -1 : DRUG DESIGN & ADVANCED MEDICINAL CHEMISTRY (OCY 15 404)

**Objectives**: The chemistry associated with drugs, its discovery, design and synthesis are very important aspects which are required for the student of chemistry. He must learnt the various drugs used for chemotherapy, and acquire necessary knowledge for the development of more drugs for treating cancer.

**Unit-I: Basic concepts in Medicinal Chemistry**
Definition of Drug, Stereochemical aspects of drugs, Classification of drugs based on chemical structure, pharmacological action and mechanisms at molecular level. Mechanism of drug action. Physical and chemical Explanation of Quintal dose, Graded dose, efficacy, potency, $LD_{50}$, $ED_{50}$ Therapeutic index,Placebo. Margin of safety, Targets of Drug action, a) Receptors concept-Types of receptors, Agonist, Antagonist. b) Ion channels. c) Enzyme specific and non specific. d) Carrier molecules.

**Unit-2: Drug Discovery**
1.a) Drug Discovery without Lead b) lead discovery Random screening – Non random screening, Drug metabolism studies clinical observations, rational approaches to lead discovery.

**Unit-3: Drug development:** Lead modification a) identification of active part pharmacophore. b) fundamental group modification c) structure activity relationship d) structure modifications to increase potency and Therapeutic index.
i) Homologation ii) chain branching iii) Ring chain transformations iv) Bioisoterism

**Unit-4: Drug Synthesis**
Definition, synthesis, Medicinal uses and adverse effects of the following
1) Antiinflammatory- ibuprofen, NSAIDS 2) antiemetic -metoclopramide 3) HI-receptor antagonist, Antihistamines - pheniramine, H1 - Antagonist (4) Anti-ulcers Ranitidine $H_2$-Antagonist omeprazole, Kt-Atpase inhibitor (5) Anti-hypertensives a)α - Blocker prezosine b) β-Blocker tenolol c) $Ca^{+2}$ channel blockers Nifedipine d) ACE- inhibitor Enalapril e) centrally active methyl dopa.

**Unit-5: Design of Antimicrobial chemotherapeutic agents:**
Introduction to Chemotherapy 1) Inhibition of cell wall biosynthesis , Design of –β-lactam antibiotics a)Penicillin: Structures of Methicillin, Ampicillin, Cloxacillin, Amoxycillin, Carbenicillin, synthesis of Phonoxy Methyl Penicillin b)Cephalosporins - Structure of Cephalexin, Cefaclor, Ceflazidine. Cefotoxime Synthesis of Cephalosporin C c) New β-lactam ring systems, structures of Imipenam and Nocardicin- A . 2) Effect on cytoplasmic membranes, Structure of nystatin 3) Inhibitors of protein synthesis , Structures of streptomycin, Gentamycin A, Tetracycline, oxy tetracycline, Doxycycline. 4) Inhibition of RNA synthesis: structure of Rifamipicin 5) Inhibition of DNA synthesis structures of Norfloxacin .

**Outcomes:** A thorough knowledge on the concepts of medicinal chemistry, lead discovery and development into a drug are learnt from this course. He also gains a good knowledge on synthesis of drugs and various drugs for facing cancer, bacterial and fungal attacks.

**Recommended books:**

1. An introduction to Medicinal Chemistry, G./L. Patrick, Oxford Press
2. Burger's Medicinal Chemistry and Drug Discovery, Vol. 105 Wiley.
3. Medicinal Chemistry, Ashutoshkar, New Age International Ltd.
4. Principles of Medicinal Chemistry, W.O.Foye, Varghese Pub. House.
5. Essentials of Medical Pharmacology, K.D. Tripathi, Jaypee Brothers
6. A text book of medicinal chemistry, P.Primo, CBS Publishers & Distribtors.
7. Text books of Pharmaceutical organic chemistry, Md Ali, CBS Publishers
8. A Text book of pharmaceutical chemistry, Jayasree ghosh
9. The organic chemistry of drug desgn and drug action, Silvermann R.Acade press.

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### Elective -2 : GREEN CHEMISTRY (OCY 15 404)

**Objectives:** Chemical pollution is an alarming issue of the present world. A chemist has to know, how to minimize the usage of chemicals and has to learn the various techniques by which the few of chemicals into soil, water and air is reduced. The applications of microwaves, ultra sonics towards reduction of thermal pollution are to be studied.

**Unit-I Introduction to green Chemistry:**
Introduction & historical background; Post-war development boom; Pollution in Rhine, Thames and Cuyahoga rivers; Ban on Exxon Company; Formation of EPA in US in 1970; World Earth Day; Bhopal Gas Tragedy; Chernobyl Disaster; Minamata Disaster.

**Unit-II Solvent free reactions:**
12 Principles of Green Chemistry; Greener routes to chemical reactions; Designing robust reaction conditions; Reaction media/Solvents for Green reactions; Atom economy; Alternative/Green (agricultural) routes to Petro-Chemicals; Energy saving in alternative chemical routes.

**Unit-III Green Technological process:**
Use of Domino, Cascade and Tandem reactions; Multi component reactions; Efficient one-pot reactions; Phase transfer catalysis; Applications of Phase Transfer Catalysts to industrial processes; Nucleophilic substitutions in Process Chemistry.

**Unit-IV Click Chemistry:**
Beyond the paradigm of carbonyl chemistry; Click chemistry reaction types; Click chemistry in water; Click chemistry in solid phase Synthesis; Synthesis of heterocycles and macromolecules.

**Unit-V Microwave and Sonication Reactions:**
Discovery and advantages; Increased reaction rates and its mechanism; Superheating effects of microwaves and its control; MAOS & its applications; Heterocyclic Synthesis; Microwave technology in process optimization.
Introduction to sonication, reactions-substitution, addition and reduction reactions.

**Outcomes:**
The student will learn the techniques like click chemistry, synthesis of compounds by using microwaves, ultrasonics and without using solvents. The green technological process are learnt by the student from this course.

**Recommended books:**
1."Green solven for organic synthesis" V.K. Ahluwaliar & Rajemder S. Varma.
2. " New Trends in green chemistry" V.K. Ahluwalia & M.Kidwai.
3. Alternative solvents for green chemists "Francesca M. Kerton RSC Publictions series.
4. "Green Chemistry fundamentals and applications" Suresh C.Ameta,Ph.D , Rakshit Ameta Ph.D ISBN :9781926895437
5. "Green Chemistry" Theory and practice: Paul T. Anastas John C. Warner, Oxford University Press ISBN-13 978-0-19-850698-0, first published in 1998,
6."Introduction to Green chemistry". Ryan M. Tinnes and M.American Chemical Society, Washington DC 2002.

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## DRUG ANALYSIS & GREEN CHEMISTRY LABORATORY (OCY 15 L41)

**1) Estimation of the following bulk-drugs/Intermediates using chemical methods:-**

a) Paracetamol
b) Aspirin
c) Phosphoric acid
d) Ibuprofen
e) Lactic acid

**2) Green Chemistry Experiments:**

a) Solid Phase Synthesis:
   i) Condensation of o-aminobenzamide with benzoic anhydride
   ii) Synthesis of N-arylphthalimide from phthalic anhydride and p-toluidine.
   iii) N-alkylation of 2-methylbenzimidazole.

b) Solution Phase Synthesis:
   i) Diels-Alder reaction between furan and maleic acid in water.
   ii) Preparation of 1,1-bis-2-naphthol from β –naphthol in the presence of $FeCl_3$ in water.
   iii) Synthesis of N-phenylphthalimide from phthalic anhydride and aniline in PEG- 600.

c) Micro-wave Irradiated Synthesis:
   i) Synthesis of 2-methylquinolone from aniline and ethyl acetoacetate.
   ii) Condensation of benzaldehyde with ethyl cyanoacetate in the presence of ammonium formate.
   iii) Three-component reaction between ethyl acetoacetate, benzaldehyde and thio-urea in DMF.

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## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**M.Sc. II Year II-Sem (Organic Chemistry)**

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## SPECTROSCOPY LABORATORY (OCY 15 L42)

**1) Spectroscopy:**

Identification of unknown organic compounds by the interpretation of their UV – Visible, IR, NMR (Proton & Carbon) and Mass Spectral data.

Each student should analyse the spectra of atleast twenty compounds.

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