

# PROGRAMME PROJECT REPORT (PPR)

**Name of the Programme:**       **MASTER OF SCIENCE IN CHEMISTRY  
(M.Sc. Chemistry)**

**Duration:** Minimum 2 years  
              Maximum 4 years

**Recognition:** This Programme was recognized by the DEC-IGNOU and now by the UGC-DEB

## A. PROGRAMME'S MISSION & VISION

### VISION:

To provide comprehensive, relevant curriculum to all students in the field of chemistry enabling them to take up careers in academic, industry and government sector along with conducting significant societal based research. Provide an opportunity to all those who could not be able to take up formal mode education in the field of chemistry and train them to enhance the knowledge and build a human resource.

### MISSION:

- The Department pledges to encourage in the broadest and most liberal manner, the advancement of science particularly in all branches of chemistry through its education, research and service.
- Foster creativity in teaching, learning and research to build a knowledge base and promote quality initiative.
- Provides advanced study in chemistry for individuals who are currently employed in chemistry-related industrial or governmental positions, or desire professional training before entering the job market or a doctoral program.

### OBJECTIVES:

- To train the students in various quantitative and qualitative analyses to critically assess and solve problems requiring the application of chemical principles.
- To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
- Demonstrate high-level of professionalism, ethical and social responsibility, independent learning, and desire for life-long learning.
- Excel in careers in the chemical, petroleum, petrochemical, pharmaceutical, food, energy, materials processing or other related industries/organizations.

## B. RELEVANCE OF THE PROGRAM WITH HEI'S MISSION AND GOALS

Kuvempu University is an affiliating State University in Karnataka. Established in 1987, it is a University with a distinctive academic profile, blending in itself commitment to rural ethos and a modern spirit. It has 37 Post-Graduate departments of studies in the faculties of Arts, Science, Commerce, Education and Law. It also has 4 constituent

colleges at Shankaraghatta and Shimoga, and two outlying regional Post-Graduate Centres at Kadur and Chikkamagalur.

The Vision and Mission of the University are:

**Vision:** Kuvempu University shall strive to become an international centre of excellence in teaching and research to provide high quality value based education to all through various modes to meet the global challenges.

**Mission:**

- Foster creativity in teaching, learning and research to build a knowledge base and promote quality initiative.
- Provide access to education to all.
- Develop human resources to meet the societal needs.

The Distance Education Programmes are a part of the University's outreach programmes for the rural masses and also to foster University-Society relationship with the motto of "Education for All", to provide quality education at the doorsteps of desirous individuals who want to take up higher education, for the discontinued who could not take up formal education, housewives and employees who want to improve and enhance their knowledge. The University firmly believes that education and seeking knowledge is a **Lifelong Learning** concept.

Offering higher education through Distance Mode is an important step taken by Kuvempu University so as to help the student community in their zeal to pursue higher education at UG and PG Level. The University felt the necessity of this when a large number of students, who wanted seats for PG. Studies, could not be accommodated in our regular P.G. Programmes. The University believes that Distance Education Mode is an equally good avenue to be made available to interested students. With these view, Kuvempu University started offering courses through distance mode since 2002-2003. At present it is offering 31 Programmes (earlier called Courses) in various faculties at the U.G., P.G. and PG Diploma levels. These programmes were approved by the erstwhile DEC-IGNOU, and now by the UGC-DEB.

### **Goals & Objectives of Distance Mode Programmes**

- Reach out to larger sections of society seeking non-formal education.
- Capacity Building using the non-formal mode platform.
- Concentrate on planning & constant upgrading of facilities to meet new challenges in education through Distance Mode.
- Provide counseling & consultancy to students.
- Offer area/ region wise educational requirements.
- Skill Development and Enhancement.
- To impart quality training through interactive learning module.
- Interactive Pedagogy of teaching-learning and flexible learning environment.
- Provide supportive academic environment and effective teaching.

### **C.NATURE OF PROSPECTIVE TARGET GROUP OF LEARNERS:**

Master of Science in Chemistry Programme, is intended for the target group of secondary level (Classes IX- X) and senior secondary level Classes (XI- XII) Teachers

who look for knowledge enhancement and carrier development. And also analytical scientists in a wide range of industries including drug, pharmaceutical, oil, food and drink, environment, biochemistry, and forensic analysis who are in need of skills and knowledge required for subsequent employment are our target learners. It is also intended for

- Qualified graduates in any stream from any recognized University who wish to see their career development in teaching and to train future educators.
- Persons who love to spent their quality time with students and want to enrich skills.
- Persons who are not able to pay higher fees in regular mode (Affordable Fee structure). Home makers who want to enhance their career.
- Young entrepreneurs who wish to acquire skills in different areas of chemical sciences.

#### **D.APPROPRIATENESS OF PROGRAMME TO BE CONDUCTED IN OPEN AND DISTANCE LEARNING MODE TO ACQUIRE SPECIFIC SKILLS AND COMPETENCE**

Education through Distance Mode has become as an important and widely accepted strategy to counteract the inadequacy of the traditional system of education to keep abreast of the new demands. Distance Education is seen as a means of passing on the benefits of recent advances in communication technology to the masses and thereby actualizing the concept of a learned society. Master of Science in Chemistry Programme provides opportunities for the in-service teachers, analytical chemist assayer, chemical instrument technician, environmental control analysis and lab assistants to understand the latest trends in teaching learning process and advancements in analytical techniques. The existing workforce can take the advantage of DDE chemistry programme to increase their skills and competence in this particular field without disturbing their work schedule. It should also endeavour to develop in the future practitioners a deep and critical awareness of professional ethics and an ability to critically engage in and reflect on practice.

Further, the Programme develops ability to apply acquired knowledge and solve problems in new or unfamiliar surroundings within broader (or multi-disciplinary) contexts related to the area of study. The Programme will expose students to the diversity and variety of educational practices, policies, settings, and contexts in India. The Programme aims to build among our graduates capabilities for ongoing self motivated professional development. The Programme will strive to develop capabilities to plan independent educational interventions in various roles such as those of curriculum developers, textbook/ material developers, teacher educators, analytical scientists and researchers. The programme would provide learners a wider and more comprehensive understanding of chemistry as field of knowledge and would accommodate a wide variety of learning needs of learners.

#### **E.INSTRUCTIONAL DESIGN:**

##### **(i) Programme Formulation:**

Proposal from the concerned PG department to commence the programme was placed before Monitoring Committee of the DDE/Syndicate. Then it will be referred to the BOS concerned for formulation and approval of the syllabus scheme pattern, time allotment for

each paper, marks allotment, scheme of examination etc., then it was placed in the Faculty meeting and then Academic Council (the highest body) of the University for its approval. After approval by both the bodies, the programme was introduced. The academic advisory body of DDE refers the matter to the concerned subject/parent department council for preparation of study material. The concern subject faculty will coordinate with the DDE and the department council, as he/she is on the member in it. Workshops for preparing study material in SLM mode are regularly conducted (with the help of IGNOU experts).

**(ii)Curriculum Design:** The Programme is of 2 years duration with annual examinations. The maximum period allowed is 4 years (double the duration). The Programme structure is as below.

Year	Course Code	Course	IA Continuous Evaluation	Term End Exam	Total
<b>Previous Year</b>	56761	Course 1: Analytical Chemistry	15	85	100
	56762	Course 2: Inorganic Chemistry	15	85	100
	56763	Course 3: Organic Chemistry	15	85	100
	56764	Course 4: Physical Chemistry	15	85	100
	Practical- I	Inorganic Chemistry Practical-I	* 20	55	75
	Practical- II	Organic Chemistry Practical-II	* 20	55	75
	Practical- III	Physical Chemistry Practical-III	* 20	55	75
		<b>Total marks</b>	<b>120</b>	<b>505</b>	<b>625</b>
<b>Final Year</b>	56771	Course 1: Analytical Chemistry	15	85	100
	56772	Course 2: Inorganic Chemistry	15	85	100
	56773	Course 3: Organic Chemistry	15	85	100
	56774	Course 4: Physical Chemistry	15	85	100
	Practical- IV	Inorganic Chemistry Practical-IV	* 20	55	75
	Practical- V	Organic Chemistry Practical-V	* 20	55	75
	Practical- VI	Physical Chemistry Practical-VI	* 20	55	75
		<b>Total marks</b>	<b>120</b>	<b>505</b>	<b>625</b>
<b>Total Marks Previous and Final Year</b>			<b>240</b>	<b>1010</b>	<b>1250</b>

\* Out of 20 IA Continuous Evaluation marks 10 marks allotted for viva and 10 marks for practical record.

**(iii)Medium of Instruction:**

The medium of instruction is English.

**(iv)Detailed syllabi:** Given as Appendix-01

**(v)Faculty and Supporting Staff Requirement**

Full time faculty in regular department will be involved in orientation counseling, and face to face programmes. Such programmes are scheduled during the vacation time of the regular department, which will meet the faculty availability and infrastructure need of ODL Programme. Coordinator of the programme, who is a regular faculty member and

the Research and Teaching Assistant (RTA) will be in-charge of the Programme, who will address the day to day academic and learner/student support aspects of the Programme.

Regarding supporting staff, DDE has a separate and well equipped wing/office to take care of all the administration and delivery aspects of ODL Programmes.

There is a separate DDE wing in the Office of the Registrar (Evaluation) for all the evaluation and certification aspects headed by a Deputy/Assistant Registrar.

The DDE and Evaluation wings are fully computerized and technical staff assist in all the activities.

#### **(vi) Instructional Delivery Mechanism**

Instructional delivery mechanism is through study materials prepared by the experts in the subjects concerned. Study materials (SLM) are prepared in-house by the faculty of the department and the faculty from sister universities.

The study material provided is the general guide and covers the course content in order the learner understand core content of the course concerned. Learners are advised to make use of the reference books in the list of books provided along with the syllabus.

**Contact Programme:** There will be a contact programme for duration of 30 days normally. A minimum of 15 theory sessions (90 min each) and 10 practical sessions (4 hrs each) for instruction by experienced and scholarly faculty will be arranged for each course and practical. There shall be interaction built around lectures, discussions, individual and group activities. A test will be conducted for the candidates in each paper at the end of the contact programme.

**Student support service:** Students can interact with the Office/Faculty through e-mails and personal visits. SMS alert facility for the students regarding dissemination of information relating to conduct of PCPs/Orientation Programme and Production file submission deadlines etc. Student Support Service is provided through online mode and grievance handling mechanism is adopted with the help of supporting technical staff. All necessary and relevant information are uploaded in the dedicated website: [www.kuvempuuniversitydde.org](http://www.kuvempuuniversitydde.org). Internal Assignments with Guidelines, previous years question papers, notifications, timetables and results are available from the website.

### **F. PROCEDURE FOR ADMISSIONS, CURRICULAM TRANSACTION AND EVALUATION:**

As outlined in Section-B, Kuvempu University has a policy to provide opportunity to maximum number of eligible and desirous candidate from all sections of the Society including a class having of low-level of disposable income, rural dwellers, women unskilled men minorities etc.

#### **(i) Eligibility for the Programme**

A candidate who has passed the examination of 3 year B.Sc. with chemistry as an optional/major or B.E/ B.Tech. in Chemistry/ B.Sc. Agri./ B.Sc. Home Science or any degree in Science having Chemistry optional from this University or any other

recognized University as equivalent thereto and passed the examination concerned is eligible for admission to the M.Sc. in Chemistry.

All the candidates who fulfill eligibility criteria are admitted to the programme. If university decides for maximum number of candidates to be admitted for Programme, admissions are made first come first basis.

## (ii) Admission Process

- Notification issued by the Directorate of Distance Education (DDE) in Regional and National News papers and in the official website.
- Uploading of the Application by the candidate through Online only.
- Payment of fee through online (various options like net banking etc.) or through banks/post offices using printout of the challan.
- Submission of the printout of the application by the candidate to DDE along with original documents for eligibility, date of birth etc., and along with fee paid receipt.
- Verification of applications- for fulfillment of eligibility criteria (marks cards) documents, fee paid details.
- Approval of the admission and issue of self learning material (Study Materials) to the students.

## (iii) Fee Structure

Figures in rupees as prescribed for the academic year 2017-18

SN	Fee Component	First Year	Second Year
Admission Orientation/Practicals and Other Components			
1	Registration	2520	-
2	Admission	980	980
3	Orientation/ Tuition fee	3080	3080
4	Study materials	4620	4620
5	Liaison	140	140
6	Practical	3780	3780
7	Practical Record,IA Books	490	490
8	Postage	420	420
9	UDF-1	140	140
Examination , Certification and Other Components			
9	Exam Fee	1450	1450
10	PR Exam	605	605
11	PPC	-	365
12	Convocation	-	900
13	UDF-2	250	-
<b>TOTAL (Rupees)</b>		<b>18475</b>	<b>16970</b>

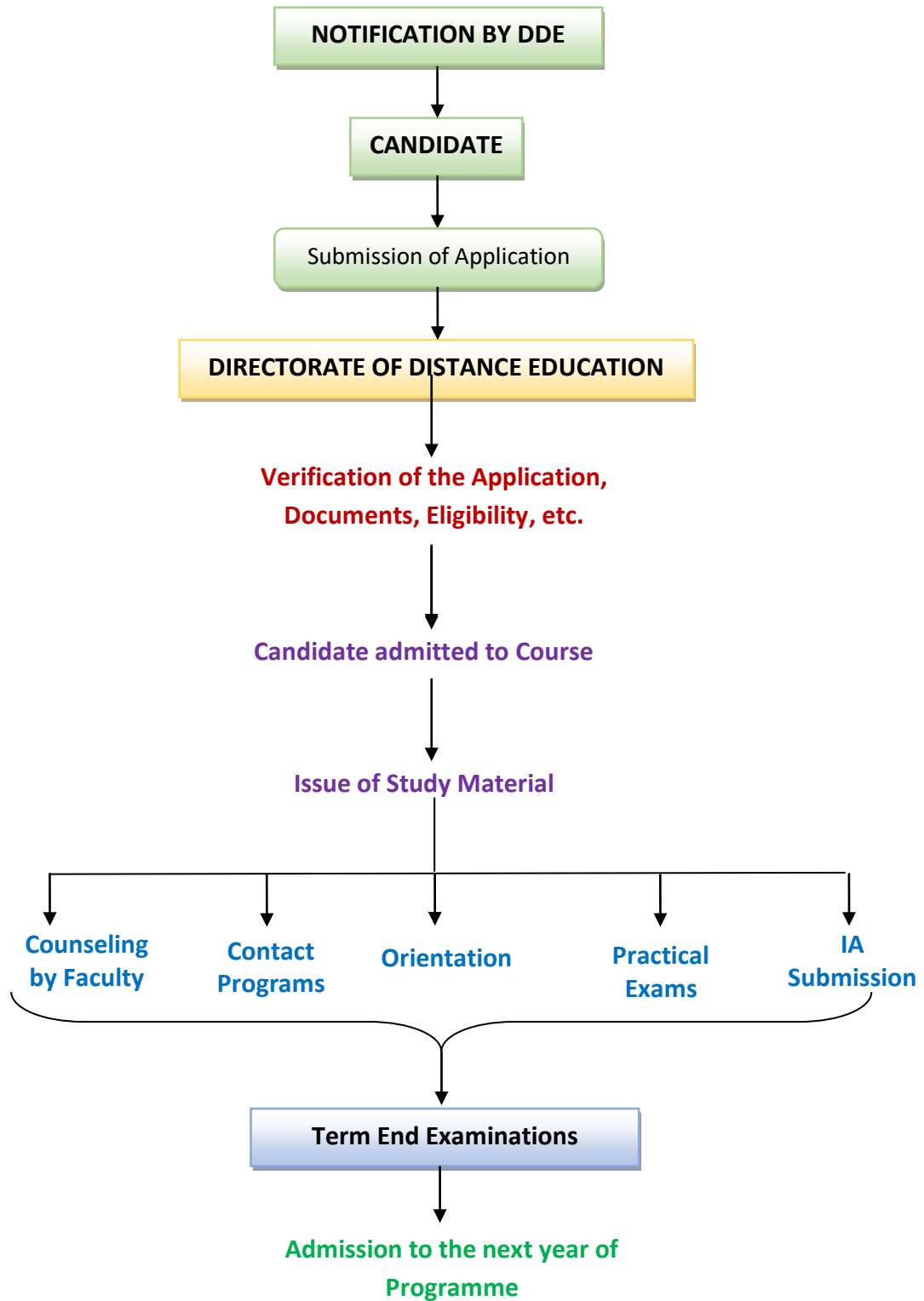
**Financial Assistance:**

- SC/ST and OBC Students can avail scholarship/fee reimbursement from the concerned State Departments/Agencies
- Fee Concession to Physically Handicap Candidates.
- Fee concession to Employees of the University and their dependents.
- Fee concession to Ex- servicemen.
- Scholarships and education supports extended by various Governmental and Non-Governmental agencies.

**(iv)Academic and Activity Planner**

Calendar Year-I		
1	Issue of Notification	July / August
2	Commencement of Online Admissions	July / August
3	Last Date for submission of online applications by the students without Late Fee	October 31
4	Last Date for submission of online applications by the students with late fee	December 31
5	Issue of Study Material and Assignment Books (immediately after verification of the applications)	July to December
Calendar Year-II		
6	Issue of assignment topics Commencement of Counseling sessions	December - January
7	Commencement of Face-to-Face (Orientation) Sessions	February –March
8	Completion of all Orientation Sessions	April 30
9	Last date for Submission of Internal Assignments/ Project Reports	April 30
10	Tentative date for commencement of Examination.	May / June
11	Declaration of Examination Results	August / September

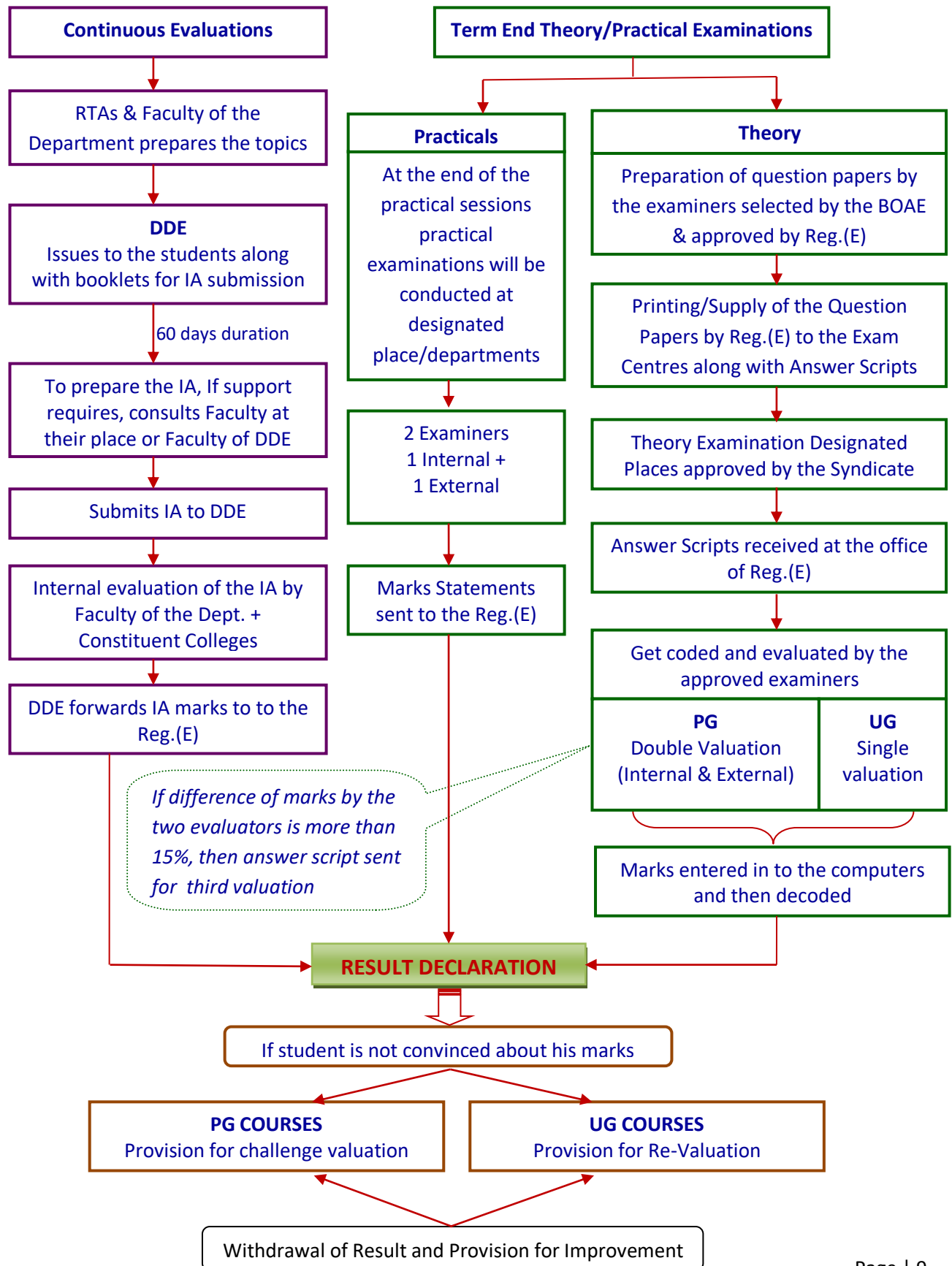
## Generalised Academic Flow Chart for the Distance Mode Learners





**(v)Evaluation of Learner Progress**

Evaluation Process is given here in the form of Flowchart. This Flowchart is common to all Programme at UG, PG and PG Diploma level offered by the University.



### Internal Assessments:

- As a part of continuous assessment the candidates will have to complete assignments in the booklets provided by DDE and submit them to the Directorate of Distance Education within the specified date. The Topics & Instructions for I.A. will be notified in the Students Corner section of the website and also issued to the students directly or through Student Counseling Centers.
- It is mandatory to submit the I.A. in the same year of registration. However, if the candidate failed to take up the theory examination, for any reason, such candidate can submit the I.A. in the next year with prior permission from the DDE.
- All students are expected to complete the above assessments before taking the Term end Examination.
- There is no provision for resubmission of I.A.

**Provision for class tests and workout exercises:** during Counseling and Face-to-Face (Orientation/Contact) programmes.

### (vi) Term End (written) Examination:

**Duration:** Duration: 3 hours, **Maximum marks:** 85

#### Questions pattern

Section	Type of Questions	Marks	Total
Part-A	Ten very short answer type without internal choice	10x2	20
Part-B	Five long answer type with internal choice	5x13	65
Total			85

#### Practicals:

- For M.Sc. Chemistry Programme, the candidates will have to attend practical sessions for specified days at designated University Departments / Colleges/ Student Counseling Centres.
- For M.Sc. Chemistry Programme consists of three practical courses in each year. Each practical course will be for 75 marks, of which 55 mark for Practical work, 10 mark for viva and 10 marks for practical record.
- The practical examination can be repeated if the candidate has failed to take up the practicals and practical examination in the concerned year. If a candidate fails to attend the regular practical course and exam, he/ she may take up the theory exam and take practicals later.

**Declaration of class:** At the completion of course evaluation (the Programme) the class will be awarded on the basis of the aggregate of marks at both previous and final examinations taken together.

Pass Class: 40% of marks or above but below 50% of marks.  
Second class: 50% of marks or above but below 60% of marks.  
First Class: 60% of marks or above.

Separate Ranks and Medals are awarded to ODL Learners. Policy for awarding ranks and medals are same as the one followed for the Regular Programme.

**Reappearing for Exams:** The unsuccessful candidates at the P.G. Examinations of a particular year are required to reappear for those courses/examinations only as per the syllabus of that year. The repeaters are therefore advised to preserve the syllabus and study material until they pass the final year of the course.

Candidates will have to complete all the exams within double the durations of the course (and not the number of attempts). The double the duration is reckoned from the year of registration.

A candidate is permitted to register for the final year examination irrespective of the number of courses gained at the previous theory exams.

### **(vii)Other Policy/Provisions**

**Renewal of Registration:** Students of II year who have failed to pay the II year programme fee in the respective year are permitted to renew their registration by paying the specified course fee along with registration renewal fee and continue their programme. However they should complete the programme within the maximum permissible period i.e., 4 years.

**Bonafide student certificate:** Those candidates who require Bonafide Certificate/ Study Certificate can obtain by submitting a written request or a filled in prescribed application form (available from the KUDDE website) along with a fee of Rs. 100/- paid either through Bank Challan or Demand Draft.

**Change of Address:** Any change in the address of the students should be intimated to the Directorate with a fee of Rs. 100/- paid through a challan of Electronic Transfer. No change of address will be entertained once the students receive their examination hall ticket. The Directorate of Distance Education is not responsible for missing correspondence due to change of address without getting address changed at DDE.

**Name Correction:** Change of Name, if any required, candidate has to make a written request along with relevant documents as proof of change of name, and by paying specified fee.

**Duplicate Registration Card:** For issue of duplicate Admission/Registration/ Enrollment card- Rs. 200/- will be charged.

**Transfer Certificate:** A Transfer Certificate is not required for admission to any of the KUDDE courses. The Directorate will also not issue Transfer Certificate at the time of completion of the course. However, for Lateral Entry admissions a migration and transfer certificate will be required from such students.

**Change of Examination Centre:** DDE will not entertain any change of exam centre unless there is a proof of change of address and it permissible.

**Discrepancies in Marks cards and certificates:** In case of any discrepancies observed in the marks card/ certificates etc., candidates have to bring it to the notice of the Director,

DDE through a written request within a period of 3 months from the date of issue of the document.

**Miscellaneous:** All the original certificates submitted by the candidates in connection with their admission, registration will be returned to them from the Office of the DDE along with the registration certificate. In case any of their certificates are not received back, they must bring the same to the notice of The Director, DDE, Kuvempu University, immediately. The original records will be maintained for a minimum period of three months. If the candidates ask for the originals before three months, their requests will not be entertained.

**Preservation of Answer Scripts / IA Scripts:** The answer scripts of Theory Exams will be preserved for a maximum duration of 6 months from the date of announcement of results/ revaluation / challenge valuation results. Any query or request for verifications may be submitted, through a written request, within the notified period only.

Similarly, written IA Scripts of the students will be preserved for a period of six months from the date of announcement of the results (First announcement of results). Any discrepancy observed regarding IA marks may be informed to DDE through a written request within three months from the date of issue of results. Later request may not be accepted.

Students are advised to refer the website for notifications regarding preservation of various documents, issued from time to time.

Notwithstanding any conditions mentioned above the University reserves the right to change, alter, and amend any of the above clauses/conditions. In matters of fees for unforeseen issues / certificates/ endorsements the University may fix the amount subject to the existing fee structure or change it from time to time.

**Post-Examination Related Issues:** For all matters regarding post-examination Certifications - such as, issue of Convocation (Degree) Certificates, Duplicate Marks Cards, Provisional Pass Certificate (PPC), Name Correction, Consolidated Marks Cards, removal of NCL, Academic Transcript, verification of genuineness of Marks Cards and Certificates, and Processing Certificates - enquiries can be made directly at the Office of Registrar (Evaluation). Candidates are informed to contact, for any related information/clarifications, the Helpdesk at the O/o Registrar (Evaluation) by telephone and e-mail ID given the website.

## **G.LIBRARY RESOURCES**

A well established library facility shall be made available with the support of the university library. In the campus we have modern and well equipped building of library in Kuvempu University offers excellent infrastructure facilities in reading, browsing and reference to the students, teachers and research scholars. The library has kept pace with modernisation by introducing CD ROM data base, internet and e-mail facilities. It is also a nodal centre for INFLIBNET, access is available to 10,000 + e-journals online under the UGC- infonet Consortia. There is a well developed digital library and campus network interconnecting all the Post-Graduate departments and offices in the campus.

Further, the DDE will made special effort to upgrade the existing DDE Library exclusively for distance learners with an emphasis on distribution of information and course material online by making use of the state-of-art information and communication technologies.

**Library Card:** Candidates who are desirous to avail themselves the facilities of Kuvempu University Main Library on the campus will be permitted. They have to obtain a separate Library / ID Card on payment of Rs. 100/- (through Challan of Electronic Transfer). However, no books will be issued to them.

## H.COST ESTIMATE OF THE PROGRAMME AND THE PROVISIONS

Cost Estimated of the Programme is based on following components  
– calculated for an admission of 100 Students:

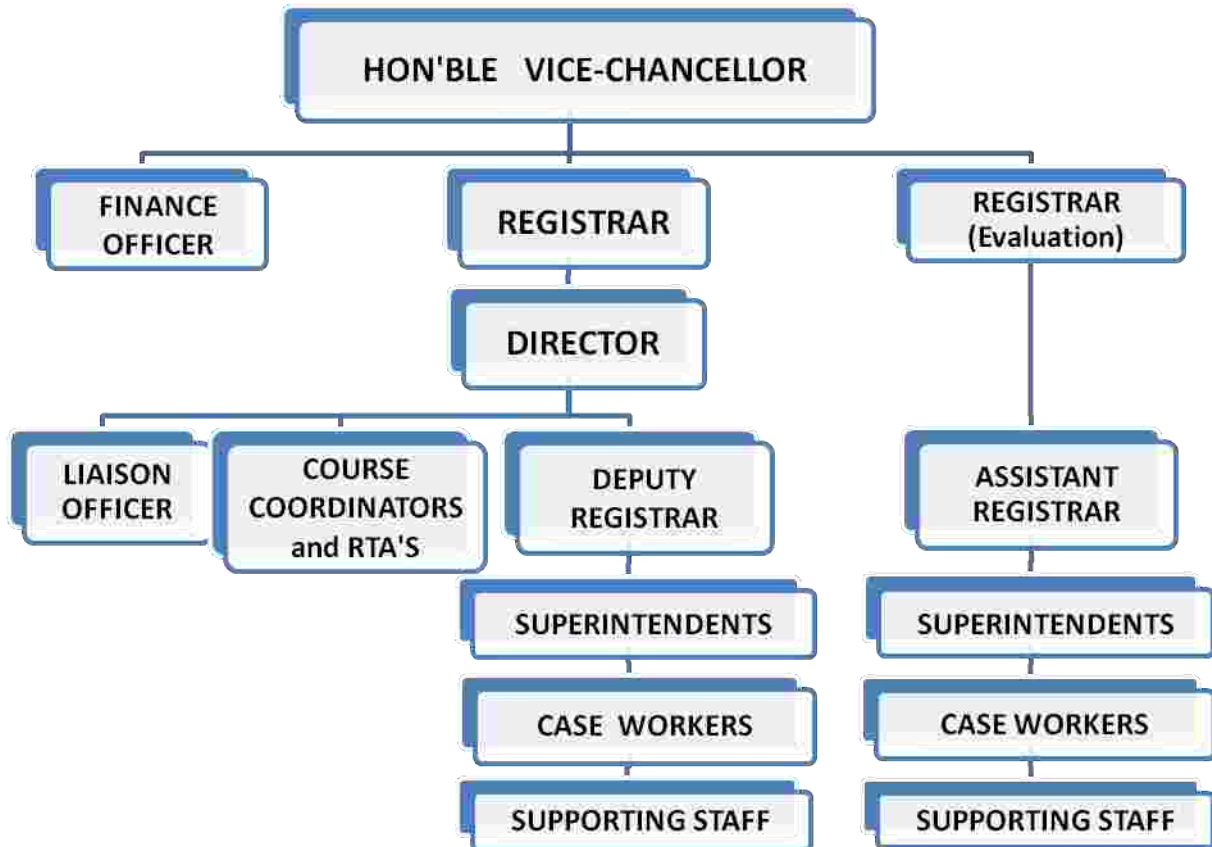
SN	Component	Estimate ( Lakh in Rupees)
1	Study Material Development – Course Writer honorarium, Review vetting, editing, SLM conversion etc	6.00
2	Printing and Distribution of SLM	5.54
3	Publicity, Awareness Information Decimation Programmes*	0.20
4	Conduction of Counselling, Orientation/Face to Face/ Practical Sessions etc.	10.30
5	Student Support Services*	0.50
6	TA/DA Meeting Expenses*	0.25
7	Continuous Evaluation / IA	0.30
8	Examination and Certification	3.75
9	Office Automation/ICT/ Communication Related Infrastructure*	0.50
10	Library*	0.46
11	Staff Salaries/ Remunerations/ Other Honorariums – Teaching, Nan-Teaching/Technical/Supporting*	1.59
12	Office Infrastructure*	0.40
13	Laboratory Development and Expenditures	0.76
14	Learner Centre Expenses*	0.36
15	Others – Office Contingence, Post/Courier, Vehicle Maintenance, Fee reimbursement and such others.*	0.67

Note: \* costs that will be incurred collectively for all the Programmes, but given here are the fractions of the total, considering 100 students admission to the Programme.

# I. QUALITY ASSURANCE MECHANISM AND EXPECTED PROGRAMME OUTCOMES

## (a) Organizational Structure, Management and Monitoring Mechanism

The Organizational Structure of the Kuvempu University Directorate of Distance Education (KUDDE) is given below in the form of flowchart.



For the administrative and policy decisions, and reviewing and monitoring of the ODL activities, Kuvempu University has a Monitoring Committee (MC) Chaired by the Honorable Vice-Chancellor. The Registrar, Registrar (Evaluation), Finance Officer, Deans of all the Faculties, Chief Librarian, One Syndicate Member, One Academic Council Member and the Regional Director of the IGNOU, are its members. The Director, DDE is the Organizing Member. The operational plans, goals and policies are decided by the MC, and all the decisions and policy matters are placed before the Monitoring Committee before implementation. The Committee normally meets twice a year to review the ODL Programmes and activities.

Academic Advisory Committee (AAC) of the DDE will review the academic programme performance, content delivery mechanism. Issues regarding course content and syllabi

revision of the entire Programme offered in ODL mode are discussed and decided in AAC. The Registrar will be the Chairman of the AAC, and Registrar (Evaluation), Chairpersons of all BOSs of the concerned Departments will be the members. The Director/ Deputy Director of the DDE is the Organising Member.

All the major decisions including financial, planning and implementation which are discussed in the MC meeting are placed before the Syndicate of the University and after its approval they will come into force.

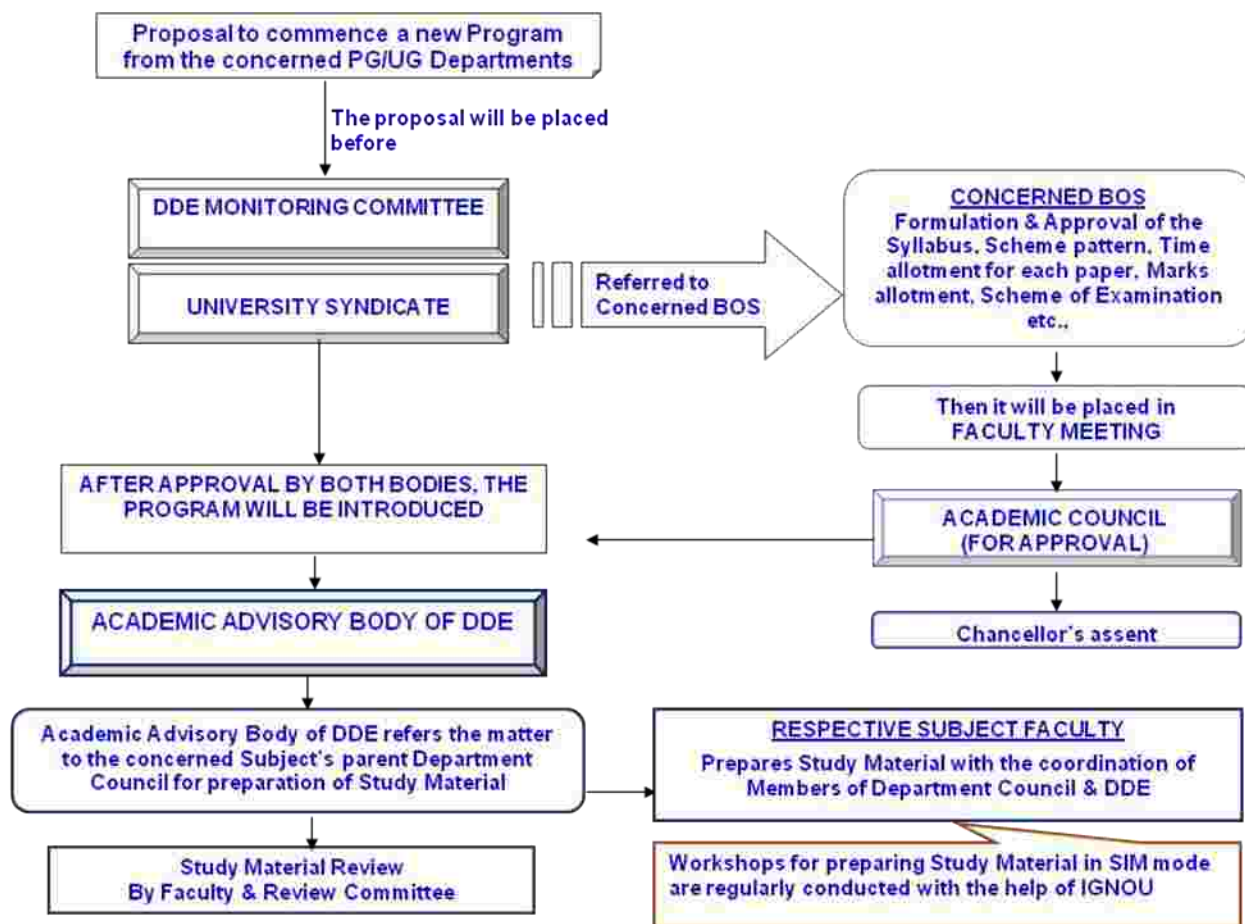
The decisions taken by the AAC are placed through the concerned bodies like, BOS/ Examination wing (for evaluation and certification issues) and finally placed before the Academic Council of the University for its approval.

For the internal quality assurance mechanism there is a Internal Quality Assurance Cell of the University.

### **(b) Programme Development and Approval Processes.**

Proposal from the concerned PG/ UG department to commence a new Programme will be placed before Monitoring Committee of the DDE/ Syndicate. Then it will be referred to the BOS concerned for formulation and approval of the syllabus, programme structure, time allotment for each paper, marks allotment, scheme of examination etc., then it will be placed in the Faculty meeting and then Academic Council for its approval. After approval by both the bodies, the programme will be introduced. The Academic Advisory Body of DDE refers the matter to the concerned Subject's/ parent Department Council for preparation of Study Material. The concern subject Faculty will coordinate with the DDE and the Department Council, as he/ she is one of the member in it. Workshops for preparing Study Material in SLM mode are regularly conducted (with the help of IGNOU experts) and preparation of course material in SLM mode is in progress.

The various steps involved in programme development, approval and implementation are depicted in the flowchart given below.



### (c) Programme Monitoring and Review

As a part of the regular monitoring mechanism, feedback from the Learners is obtained at the end of each of the face-to-face programmes - both through discussion and through written feedback form. Feedback form includes mainly three aspects – about appropriateness/ usefulness of learning (study) materials, effectiveness of orientation/ face-to-face programmes and internal assessments/continuous assessment process. Learner can give their opinion, suggestions and complaints, if any, through the feedback form. Issues raised in feedback are addressed at appropriate level.

There is also Student Support Service and Grievance Cell in DDE in order to address the day-to-day issues faced by the Learners. The Research and Teaching Assistants at DDE and the Coordinator in the concerned the subjects are available for the learner support services. These apart, regular meetings of concerned faculty are conducted in order to plan the orientation and practical session's activity.

It is the policy of the KUDDE to make available the expert faculty of the PG Departments/ Colleges (for UG) and experts from the sister universities in the state who are regular faculty in the respective subjects for the ODL programmes. The same is followed for the Learner Support Centers (LSC). Programme delivery/academic activities at the LSC are also monitored from the Headquarter.

DDE is organizing Coordinators Meet every year wherein all the issues related to ODL programmes – academic, examination, learners related and administration are discussed and remedial measures are considered under the ODL framework of the university. During the Meet academic activities/learners' issues at the LSC are also reviewed.



**Detailed Syllabi of M.Sc. in Chemistry Programme.****FIRST YEAR – M. SC. PREVIOUS (THEORY AND PRACTICAL)****56761: ANALYTICAL CHEMISTRY****UNIT 1: Evaluation of Analytical Data**

Types of errors, determinate and indeterminate errors, methods of minimizing of errors, accuracy and precision, significant figures, mean, median, standard deviation, distribution of random errors, statistical treatment of finite samples, reliability of results, least square method and curve fitting-criteria for rejection of an observation. Q, F and t - test; comparison of results.

**UNIT 2 : Titrimetric and gravimetric methods of analysis**

**Titrimetry:** Theory of Indicators-Indicator action to be explained with suitable examples. Introduction: theoretical basis for titrimetric analysis, classification of titrimetric methods: Acid base titrations, Redox titrations, Complex formation titrations and precipitation titrations; Titrations in non-aqueous media.

**Gravimetry:** General principles, conditions for precipitation, choice of precipitants, advantages of using organic precipitants, factors influencing the solubility of precipitates, theories of precipitations, post-precipitation, co-precipitation, effect of digestion, precipitation from homogeneous solutions (PFHS), pH changes, ion release reagents, change in oxidation states, use of mixed solvents and analytical applications.

**UNIT 3: Separation Techniques**

Solvent extraction (liquid- liquid extraction), General principles, nature of partition forces ( dispersion, interaction, dipole - dipole interaction, induction interaction, hydrogen bond interaction), Relationship between percentage of extraction and distribution coefficient, distribution coefficient and distribution ratio, extraction of metal organic complexes and ion association complexes, multiple extraction.

**UNIT 4: Non - aqueous solvents**

Self ionisation reactions, acid - base concept in non - aqueous media. Reactions in liquid  $\text{NH}_3$ , anhydrous  $\text{H}_2\text{SO}_4$ ,  $\text{CH}_3\text{COOH}$  and liquid  $\text{SO}_2$ . alkali metal solutions in  $\text{NH}_3$  and their characteristic properties.

**UNIT 5: Environmental Chemistry**

**Air pollution:** types of pollutants; particulate matter,  $\text{SO}_x$ ,  $\text{NO}_x$ ,  $\text{CO}_x$ ; CFCs – sources and effects on vegetation, materials and health photochemical smog, fog Green house effect, global warming, acid rain.

**Air quality standards;** Air pollution sampling; monitoring of particulates,  $\text{SO}_2$ ,  $\text{NO}_x$ , CO and HCs; particulate and gaseous emission control.

**Water pollution:** Water quality standards; water pollution-industrial, agricultural and domestic sewage. B.O.D., C.O.D. and their determination.

**Toxic chemicals in the environment** - biochemical effects of As, Cd, Pb, Hg, CO,  $\text{NO}_x$  and  $\text{SO}_x$ . Some case studies of air and water pollution.

## **UNIT 6: Chromatographic Techniques**

Classification, basic principles. Theories of chromatography – Plate theory and rate theory – sources of zone broadening – Van Deemter's equation adsorption isotherms.

Ion exchange chromatography: Ion exchange process, synthesis and structure of ion exchange resins, resolution, retention parameters selectivity, ion exchange capacity, applications in the removal of interfering ions, lanthanide separation, concentration and recovery of tracer ions.

## **UNIT 7: Gas chromatography**

Characteristics of mobile and stationary phases used in GSC and GLC characteristics of carrier gas, detectors – TCD, FID and ECD. Application of GC in the analysis of gaseous pollutants, petrochemical, GC and GC-MS.

## **UNIT 8: Planar chromatography, paper and thin layer chromatography:**

Stationary and mobile phases various techniques of development – visualisation and evaluation of chromatograms. Applications: separation of inorganic and organic compounds.

## **UNIT 9: Gel permeation/filtration (Exclusion) chromatography**

Introduction, theory and principles of size exclusion process – materials for size exclusion processes – calibration techniques – Weight average and number average concept – Applications in polymer chemistry.

## **UNIT 10: Affinity chromatography**

Basic theory, separation mechanism – on affinity column – matrices matrix activation – Application.

## **UNIT 11: High performance liquid chromatography (HPLC)**

Scope of HPLC, Introduction, principle – instrumentation – detectors, column preparation, applications.

### **References:**

01. Principles of Quantitative chemical Analysis – Robert de Levie, International edition 1997 McGraw Hill Co.
02. Quantitative Analysis – Day and Underwood, Printice Hall Indian, Pvt Ltd. 6<sup>th</sup> Ed. (1993).
03. Vogel's Text book of quantitative chemical analysis – Revised by G.H.Jaffery, J.Bassett, J.Mendham and R.C.Denney ELBS 5<sup>th</sup> edition (1998).
04. Spectroscopy of organic compounds – P.S.Kalasi Wiley Eastern Ltd., India, 1993.
05. Organic spectroscopy – William Kemp 3<sup>rd</sup> edition ELBS.(1991).
06. Nuclear magnetic Resonance – P.J.Hore Oxford Science Publications (1995).
07. Introduction to Instrumental Analysis – R.D.Braun McGraw Hill International editions (1987).
08. Fundamentals of molecular spectroscopy G.M. Barrow McGraw Hill Book Co. (1982).
09. Fundamentals of molecular spectroscopy C.N.Banwell Tata McGraw Hill,Book Co.(1973).
10. Nuclear magnetic Resonance, Basic Principles,Attur Rahman: Springer Verlag, New York Inc (1986).
11. Physical methods in Inorganic - R.Drago, Affiliated to East west Pvt. Ltd, (1968).
12. Spectroscopic identification of organic compounds – Selverstan Bessler and Morrill John – Wiley and sons (1991).
13. Introduction to chromatography – Theory and practical V.K.Srivastava and K.K.Srivastava S.Chand Co. Ltd., 4<sup>th</sup> edition (1991).

14. Analytical chromatography – G.R.Chatwal. Himalya Publishing House. 7<sup>th</sup> Ed.(1998).
15. Spectroscopic methods in Organic Chemistry – D.H.Williams and Ian Fleming Tata – McGraw Hill, 4<sup>th</sup> Ed. (1988).
16. Computers in Chemistry – Raman Tata McGraw Hill, (1993).
17. Basic concepts of Analytical Chemistry – S.M.Khopkar, New Age International Publishers, 2<sup>nd</sup> Ed. (1998).
18. Molecular Structure and Spectroscopy – G.Aruladas, Prentice Hall India, New Delhi (2001).
19. Principles of Instrumental Analysis - Skoog, Holler and Nieman, HarCourt Asia Private Limited, New Delhi, 5<sup>th</sup> Ed. (1998).
20. Fundamentals of Analytical Chemistry - Skoog, Holler and Nieman, HarCourt Asia Private Limited, New Delhi, 7<sup>th</sup> Ed. (1998).
21. Instrumental Methods of Chemical Analysis – H.Kaur, Pragathi Prakashan,Merat, 1<sup>st</sup> edition 2001.

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## **56762: INORGANIC CHEMISTRY**

### **UNIT 1: Chemical Bonding**

Ionic bond - Properties of ionic compounds, close-packing of ionic compounds, ionic radii, factors affecting ionic radii, radius ratio rule and structures, of NaCl, Cs Cl, CaF<sub>2</sub> and TiO<sub>2</sub>. Lattice energy, Born - Lande equation, Born - Haber cycle - applications. Hydration energy, lattice energy and solubility of ionic solids. Defects in crystal structures-Schottky and Frenkel defects, color centers. Band theory of Metallic bonding - insulators, conductors and semiconductors; n-& p-type semiconductors, p-n junctions, mixed oxides - spinels and perovskites.

Covalent bond -Valence Bond approach, orbital overlap, resonance and hybridisation.M.O.T. - LCAO method - sigma, pi and delta M.Os., M.O. treatment of homo and hetero diatomic molecules. MOEDs, electron configuration, stabilities and magnetic properties. Polar covalent bonds – dipolemoments and % ionic character. Size effects, polarising power and polarisability of ions, Fajan's rules. Covalent character in ionic bonds

### **UNIT 2: Hybridization and Shapes of polyatomic molecules**

Application of VSEPR theory in explaining the structure of molecules – AB<sub>2</sub>E, AB<sub>3</sub>E, AB<sub>2</sub>E<sub>2</sub>, AB<sub>3</sub>E<sub>2</sub>, AB<sub>4</sub>E, AB<sub>4</sub>E<sub>2</sub>, AB<sub>5</sub>E and AB<sub>5</sub>E<sub>2</sub> types.

### **UNIT 3: Bonding in Organic Molecules**

Nature of bonding in organic molecules- V.B. & M.O.T. and hybridization. Elctronegativity, inductive effect, concept of resonance, resonance rules and resonance effect, Conjugation and Cross conjugation. . Concept of hyperconjugation and tautomerism (with special reference to keto-enol tautomerism and valence tautomerism.

### **UNIT 4: Bonding in metal complexes**

Valence Bond and Crystal Field Theory - salient features. Crystal Field Splitting of d-orbitals in octahedral, tetrahedral, tetragonal and square planar fields. Magnitude of  $\Delta$ , factors affecting  $\Delta$ , CFSE, evidences for crystal field stabilisation, short comings of CFT, evidences for covalency. M.O.T. of complexes involving sigma and pi-bonding, M.O. energy level diagrams for octahedral and tetrahedral complexes. Jahn-Teller distortion; Chelate, Template and macrocyclic effects.

### **UNIT 5: Boranes**

Diborane carboranes and mettallo - boranes -preparation, chemistry structure, bonding and topology. Wades rules, Styx number.

### **UNIT 6: Allotropy and catenation in group IV elements**

Diamond and graphite: structure and properties; Metal carbides – self-like, covalent and interstitial carbides; intercalation compounds of graphite, alkali metals, intercalation compounds with metal helides; with oxides, sulphides and halogens Silicon dioxide: silicates: types ortho-pyro, cyclic, sheet and threedimentttional; mica, clay, zeolite –structures and applications: halides and hydrides of silicon - silicone polymers – fluids, gums, resins and clastomers. P-N and B-N ring, cage and polymeric compounds, polyphosphates and borophosphate glasses. Nitrides of sulphur – (SN)<sub>2</sub>, (SN)<sub>4</sub>, (SN)<sub>x</sub> – preparation, properties, structure:

### **UNIT 7: Interhalogen compounds**

ClF, BrCl, IBr, ClF<sub>3</sub>, BrF<sub>3</sub>, UF<sub>5</sub>, BrF<sub>5</sub> – IF<sub>5</sub>, IF<sub>7</sub>: properties and structure. psuedohalogenas – cyanogen and thiocyanogens.

### **UNIT 8: Noble gas compounds**

Reactivity of noble gases: Fluorides of xenon-XeF<sub>2</sub>, XeF<sub>4</sub>, XeF<sub>6</sub>; oryflenorides; XeOF<sub>2</sub>, XeOF<sub>4</sub>, XeO<sub>2</sub>F<sub>2</sub>; preperation, properties and structure of these compounds.

### **References:**

01. Advanced Inorganic Chemistry, (5<sup>th</sup> edition)-F.A.Cotton and G.Wilkinson; John Wiley and Sons.1988.
02. Inorganic Chemistry: Principles of Structure and Reactivity (3<sup>rd</sup> edition)-James E.Huheey, Ellen E.Keither and Richard L.Keither: Harper Cllins College Pub., 1993.
03. Theoretical Inorganic Chemistry (2<sup>nd</sup> edition)-M.C.Day, Jr and J.Selbin; Affiliated East-West Press, New Delhi.
04. Concise Inorganic Chemistry-J.D.Lee; ELBS, 1991.
05. Solid State Chemistry and its Applications – Antony R.West: John Wiley & Sons.
06. Modern Inorganic Chemistry – W.L.Jolly, McGraw Hill, New York, 1984.
07. Theoretical Principles of Inorganic Chemistry, 4ed, - G.S.Manku, Tata McGraw Hill, 1990.
08. Synthesis and Characterisation of Inorganic Compounds-W.L.Jolly, Prentice Hall.
09. Environmental Chemistry – A.K. De, Wiley Eastern
10. Environmental Pollution Analysis – S.M. Khopkar, Wiley Eastern.

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## **56763 – ORGANIC CHEMISTRY**

### **UNIT 1: Organic Reactions**

Terminology and classification of reagents and reactions. Formation, stability. Structure and reaction given by reactive intermediates viz., Carbocation, Carbanion, Free radical, Carbenes and Nitrenes.

### **UNIT 2: Stereochemistry**

Concept of Chirality: Symmetry elements and chiral structures. Absolute configuration- DL and R S nomenclatures.

Optical isomerism: Definition of enantiomers, diastereomers, epimers and racemic mixtures with suitable examples. Optical isomerism exhibited by lactic acid, tartaric acids, biphenyls, allenes and spiranes.

Cis-trans, syn-anti and EZ notations for geometrical isomers. Determination of configuration of geometrical isomers (Physical and Chemical methods).

### **UNIT 3: Nucleophilic Substitution at Saturated Carbon**

Mechanism and stereochemistry of nucleophilic substitution reactions – SN1, SN2 and SNi reactions. Effect of solvent and nature of substrate on these reactions. Neighboring group participation and substitution at allylic carbon atom.

### **UNIT 4: Aromaticity**

Huckle's rule and concept of aromaticity. Aromaticity of cyclopropyl cation, cyclopentadienyl anion, tropylium cation, annulenes and heteroannulenes.

### **UNIT 5: Aromatic Electrophilic Substitution Reactions**

Mechanism of aromatic nitration, halogenation, sulphonylation, alkylation and acylation. Orientation and reactivity (directive effect of substituents).

### **UNIT 6: Addition Reactions**

Addition to Carbon-Carbon multiple bonds: Addition reactions involving electrophiles, nucleophiles and free radicals. Cyclic mechanism, orientation and stereochemistry of addition of halogen and halogen acid. Addition to C=O and C=N systems.

### **UNIT 7: Elimination Reactions**

Discussion of E1, E2 and E1cB mechanisms. Orientation during elimination reactions – Saytzeff and Hoffmann rules. Chugave and Cope eliminations.

### **UNIT 8: Chemistry of Natural Products I**

#### **Carbohydrates**

**Monosaccharides:** Structure and configuration of monosaccharides – Glucose and Fructose. Anomeric effect, Hudson's rules.

**Disaccharides:** Elucidation of structures of sucrose and maltose.

**Polysaccharides:** Structural determination of cellulose and starch.

### **UNIT 9: Chemistry of Natural Products II**

#### **Proteins**

**Amino acids:** Classification and synthesis of amino acids Gabriel phthalimide synthesis, Melonic ester synthesis, Azlactone synthesis and Hydantoin synthesis.

**Peptides:** Synthesis of peptides – use of different blocking agents.

**Structure of Proteins:** End group analysis and brief account of primary, secondary and tertiary structure of proteins.

### **UNIT 10: Heterocyclic Compounds:**

Synthesis and reactivity of: furan, thiophene, pyrrole, indole, pyrazoles, pyridine, quinoline, isoquinoline and pyrimidine.

Crown ethers: Preparation, properties and applications of 18-Crown-6-ether.

## References:

01. Advanced Organic Chemistry-Reactions, Mechanisms and Structure. By Jerry March, John Wiley.
02. Advanced Organic Chemistry-By F.A. Carey and R.J. Sundberg, Plenum.
03. Structure and Mechanism in Organic Chemistry – By C.K.Ingold, Carnel University Press.
04. Principles of Organic Synthesis- By R.O.C. Norman and J.M. Coxon, Blackkie Academic and Professionals.
05. Reaction Mechanism In Organic Chemistry By S.M.Mukarji and S.P.Singh, MacMillan (India).
06. A Guide to Mechanism in Organic Chemistry- By Peter Sykes,Longmann.
07. Stereochemistry of Organic Compounds By D.Nasipuri, New Age International.
08. Natural Products: Chemistry and Biological Significance By J Mann, R.S. Davidson, J.B. Robbs, D,V, Banithrop and J.B. Horbone, Longmann.
09. Organic Chemistry of Natural Products (Vol I an II) By G.urdeep R. Chatwal, Himalayan Publishing House.
10. Stereochemistry of Organic Compounds By P.S. Kkalsi, New Age International.
11. Organic Chemistry (Vol I and II) By I.L.Finar.
12. Heterocyclic Chemistry By J.A.Joule,K,Mills and G.F. Smith, Chapman and Hall.
13. Heterocyclic Chemistry \_Vol. 1-3) By R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
14. Modern Organic reactionsBy H.O.House Benjamin.

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## 56764- PHYSICAL CHEMISTRY

### UNIT 1: Atomic structure and wave mechanics

The  $e/m$  of an electron, Charge on electron, Mass of electron, Proton, Rutherford's atomic model, Objection to Rutherford's model, Quantum theory of radiation, Photo-electric effect, Dual nature of light, Bohr's theory of hydrogen atom, Bohr's radius, Energy of electron, The spectrum of hydrogen atom, Sommerfeld's extension of Bohr's theory, Objection to Bohr's model, Dual character of electron, De Broglie's equation, Davission and Germer experiment, Heisenberg's uncertainty principle, Compton effect, Quantum mechanics or wave mechanics, Postulates of quantum mechanics, The Schrodinger wave equation, Significance of wave equation

### UNIT 2: Thermodynamics

Importance of thermodynamics, Limitations of thermodynamics, Terminology of thermodynamics, Systems, Macroscopic properties, State variables, Thermodynamic equilibrium, Isothermal, Adiabatic, Isobaric, Isochoric, Reversible and Irreversible processes. Nature of work and heat, Law of conservation of energy, First law of thermodynamics, Internal energy, State functions. Exact and inexact differentials, Euler's reciprocal relation, Cyclic rule, Enthalpy of a system, Heat capacity, Correlation between  $C_p$  and  $C_v$ . Expansion of an ideal gas, Isothermal expansion, Work done in reversible isothermal expansion, Work done in reversible isothermal compression, Maximum work, Work done in irreversible expansion, Adiabatic expansion, Reversible adiabatic expansion, Irreversible adiabatic expansion, Comparison of isothermal and adiabatic expansions, Reversible isothermal expansion of real gases, Work of expansion, Internal energy change, Enthalpy change, Heat change, Comparison of work for an ideal and real gas, Joule-Thomson effect, Joule-Thomson

coefficient, Joule-Thomson coefficient in an ideal gas and in real gases, Inversion temperature, Zeroeth law of thermodynamics.

### **UNIT 3: Chemical Kinetics**

Rate of reaction, Rate equation, Rate constant, Order of a reaction, Units of rate constants, Integration of rate expressions, First-order reactions, Second order reactions, Third-order reactions, Zero-order reactions, Half-life time of a reaction,  $t_{1/2}$  for first-order reaction,  $t_{1/2}$  for second-order reaction,  $t_{1/2}$  for  $n^{\text{th}}$ -order reaction, Order and molecularity of a reaction.

### **UNIT 4: Catalysis**

Catalysis, Auto-catalysis, General characteristics of catalytic reactions, Acid-base catalysis, Enzyme catalysis, Mechanism and kinetics of enzyme-catalysed reactions, Michaelis-Menten equation. (involving organometallic compounds)

### **UNIT 5: Ionic equilibria**

Acids and bases: Arrhenius concept, Proton transfer theory, Conjugate acids and bases, Influence of solvent on acid strength, Lewis concept, Dissociation of a weak acid, Dissociation constant of polybasic acids, Dissociation of a weak base, Ionic product of water, pH scale, Buffer solutions, Buffer capacity, Buffer index, Buffer mixture of a weak acid and its salt, Calculation of pH values of buffer mixtures, Henderson's equation, Buffer mixture of a weak base and its salt, Hydrolysis of salts, Salts of strong acids and strong bases, Salts of weak acids and strong bases, Hydrolysis constant, Relation between  $K_h$ ,  $K$  and  $K_w$ . Degree of hydrolysis, pH of hydrolysed solution, Acid-base indicators, Acid-base titrations and use of indicators.

Relative strengths of acids and bases, leveling effect of solvents. Hard and Soft acids and bases – Pearson's concept, HSAB principle and its applications; basis of hard-hard and soft-soft interactions.

### **UNIT 6: Organic Acids and Bases**

Bronsted and Lewis concepts. Effect of substituents on strengths of acids and bases (with appropriate examples).

### **UNIT 7: Electromotive force of Galvanic cells**

Galvanic cells, Some common reversible electrodes, Hydrogen electrode, Calomel electrode, Single electrode potential, Electric energy in a galvanic cell, Electrical energy and free energy change of a cell reaction, Electrical energy and enthalpy of a cell reaction, Electromotive force and equilibrium constant of a cell reaction, Nernst equation, Standard electrode potentials, Electrochemical series, Electromotive force of galvanic cells, The cell reaction, Activity and mean ionic activity of electrolytes, Activity coefficient, Concentration cells.

### **UNIT 8: Electroanalytical Technique**

Basic concepts, Ion selective electrodes, Terminology, Mechanisms, performance and applications of ISE. Coulometric methods - Principle and applications. Electrogravimetry-Theory of electro analysis, electrode reactions, over voltage, Completeness of deposit, Character of the deposit electrolytic separation of metals with controlled cathode potential.

Polarography and related methods – Theory of classical polarography, dropping mercury electrode (DME), polarograms, polarographic measurements, polarographic currents, Ilkovic equation, current and concentration relationship, half wave potentials, oxygen interference, advantages and limitations. Qualitative and quantitative analysis, organic polarography, Pulse and derivative polarography, amperometry, coulometry of controlled potential and constant

current. Cyclic voltammetry - basic principles, measurements of cathodic and anodic peak currents, current and concentration relationship and applications.

### References:

1. Principles of Physical Chemistry Puri, Sharma & Pathania, S. N. Chand & Co., 1996.
2. Advanced Physical Chemistry, Gurudeep Raj.
3. Electrochemistry, B.K. Sharma.
4. Physical Chemistry, Atkins, ELBS, 1982.
5. An Introduction to Chemical Thermodynamics R.P. Rastogi and S.S. Misra, Vikash Publications, New Delhi, 1978.
6. Essentials of Nuclear Chemistry, H.J. Arnikaar, IV Edition, New Age International (P) Ltd., 1994.
7. Physical Chemistry, K.J. Laidler and J.H. Meiser, II Edition, II Edition, II Edition, CBS Publishers and Distributors, 1999.
8. Textbook of Physical Chemistry, S. Glasstone, II Edition, Macmillan India, 1974.
9. Introduction to Quantum Chemistry, Chandra, Tata McGraw Hill, New Delhi.
10. Quantum Chemistry, R.K. Prasad, II edition, New Age Int., 2000.

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### PRACTICAL – I: INORGANIC CHEMISTRY

01. **Complexometric titrations:** Use of EDTA in the determination of Ca, Mg, Ni, Cu, Zn and Pb.
  - (i) Determination of hardness of water
  - (ii) Determination of Sulphate (by EDTA back titration after precipitation as  $\text{BaSO}_4/\text{PbSO}_4$ )
  - (iii) Determination of aluminum and magnesium in antacids by EDTA titration.
02. **Redox titration:** Determination of Fe by titration using  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{Ce}(\text{SO}_4)_2$
03. **Gravimetric determinations:**
  - (i) Cu as  $\text{CuSCN}$
  - (ii) Ni as  $\text{Ni}(\text{dmg})_2$
  - (iii) Al as oxinate
04. **Colorimetric determination** of Fe using SCN and phen.
05. **Masking experiment:** Determination of copper in the presence of iron using  $\text{F}^-$  as masking agent.
06. **Analysis of Ores**
  - (i) Limestone: Ca by oxalate precipitation and  $\text{KMnO}_4$  titration
  - (ii) Hematite: Fe by  $\text{K}_2\text{Cr}_2\text{O}_7$  titration
  - (iii) Pyrolusite: Mn by oxalate method
07. **Separation and determination**
  - (i) Cu and Fe: Ammonia separation  
Determination of Fe: Gravimetrically (PFHS method) and Cu by Iodometric method
  - (ii) Cu and Ni: Separation of Cu as  $\text{CuSCN}$   
Determination of Cu: Gravimetrically as  $\text{CuSCN}$  and Ni by EDTA titration.
08. Analysis of stainless steel for Cr, Ni and Mn
09. Ion-Exchange: Separation and determination of Zn and Mg as chlorocomplex-anions.
10. **Flame Photometry:** Determination of Na and K

### References:

01. Quantitative Chemical Analysis – I.M. Kolthoff, E.B. Sandell, E.J. Meehan and S. Bruckenstein, Mac Millan Company, 1968.



02. Vogel's Textbook of Quantitative Chemical Analysis – G.H. Jeffery, J.Bassett, J.Mendhan and R.C. Denney, ELBS, Longman, 5<sup>th</sup> Ed., 1989.
03. Advanced Practical Inorganic Chemistry – Gurdeep Raj, Goel Publishing House, 10<sup>th</sup> Ed., 1994.
04. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, ELBS, Longman, 3<sup>rd</sup> Ed., 1961.
05. Quantitative Analysis – R.A. Day and A.L. Underwood, Prentice Hall of India Pvt. Ltd., 1993.
06. Commercial Methods of Analysis – Snell and Biffen.

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## PRACTICAL-II: ORGANIC CHEMISTRY

### Qualitative Analysis:

Separation of Organic Binary Mixture, identification of its components and preparation of derivatives. [ Only Solid + Solid mixtures not involving use of ether]

### Preparation:

Single step preparation involving reactions

Substitution reactions,

Oxidation reactions,

Sandmeyer reaction,

Cannizarro reaction.

Purification by recrystallization and determination of melting point of the prepared samples.

### References:

01. Vogel's Text Book of Practical Organic Chemistry, By Furniss, Hannaford, Smith and Tatchell ELBS Longmann.
02. Advanced Practical Organic Chemistry By N.K. Vishnoi, Vikas Publishing House.
03. Handbook of Practical Organic Chemistry By Clark.
04. Practical Organic Chemistry By Agrawal.

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## PRACTICAL –III: PHYSICAL CHEMISTRY

### AAcid-base titrations

- 1.Preparation of std. PHP and Oxalic acid solutions.
- 2.Preparation and standardization of NaOH solution.
- 3.Preparation and standardization of HCl, CH<sub>3</sub>COOH using std. NaOH solution.
- 4.Preparation of Indicators (Starch, Phenolphthalein, etc.,)

### BRedox titrations

- 1.Preparation of std. K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution.
- 2.Preparation of FAS solution and standardization using std. K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution.
- 3.Preparation and standardization of KMnO<sub>4</sub> using std. Oxalic acid solution.

### CChemical kinetics

- 1.Acid catalyzed hydrolysis of Methyl acetate.

2. Acid catalyzed hydrolysis of Ethyl acetate.

**References:**

1. Experiments in Physical Chemistry J.C. Ghosh, Bharati Bhawan Publishers and Distributors, Patna, 1988.
2. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House, Meerut, 1993.
3. Vogel's Textbook of Quantitative Chemical Analysis, G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney, V Edition, ELBS Publication, 1989.
4. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill Publishing Co. Ltd.
5. Findley's Physical Chemistry, J.B. Levitt, Longman Publications.

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## **M.Sc. Final Year Syllabus (Theory and Practical)**

### **56771: ANALYTICAL CHEMISTRY**

#### **UNIT 1: Molecular Symmetry and Group Theory**

Symmetry elements and Symmetry Operations – rotation axis, plane of symmetry, rotation reflection axis, center of symmetry and identity. Product of symmetry operations. General relationship among symmetry, elements and operations.

Group theory- Concept of group, properties of group, definition of point groups, procedure for classification of molecules into point groups, group multiplication tables, representation of symmetry operations as matrices. Reducible and irreducible tables, orthogonality theorem, derivation of character tables for  $C_{2V}$ ,  $C_{3V}$  and  $D_{2h}$  point groups. Symmetry and dipole moments. Application of group theory to spectroscopy (Deduction of selection rules for spectroscopic transition).

#### **UNIT 2: Computer applications in Chemistry:**

Computers a overview, Basic need of data processing, Computer system configuration – input, output, processing units. Types of computers, operating systems, software and hardware, storage systems.

#### **UNIT 3: General introduction to spectroscopy :**

Nature and interaction of electromagnetic radiations, energies corresponding to various kinds of radiations, atomic and molecular transitions, selection rules spectral width, factors influencing positions and intensity of spectral lines.

#### **UNIT 4: Electronic Spectroscopy (Absorption spectroscopy)**

Quantitative aspects of absorption measurements - Beer's law and its limitations, terminology associated with electronic spectroscopy, types of absorption bands and theoretical interpretation, effect of solvent and structure on  $\lambda$  max and theoretical prediction of  $\lambda$  max for polyenes,  $\alpha, \beta$  - unsaturated aldehydes, ketones (Woodward - Fieser rules) and substituted benzenes. Instrumentation, application, Qualitative and Quantitative analysis, structure determination, measurement of dissociation constants of acids and bases, simultaneous determination of binary mixture ( Cu and Ni), Composition of complexes.

Computer programming:- Flow chart preparation, - development of programme, computer languages – Basic, FortranC. Characters, constants, variables arithmetic expressions. Statements – input / output, Go To, If, Do, Loops, Storing of data through Dimension statement.

Applications:- Kinetics – Solving rate equations. Thermodynamics – calculation of thermodynamic properties – enthalpy, entropy changes.

### **UNIT 5: Nuclear Magnetic Resonance (NMR ) Spectroscopy:**

Types of nuclei, theory of population of nuclear magnetic energy levels and relaxation process - chemical shifts, mechanism of shielding, spin - spin coupling, rules governing the interpretation of first order spectra. low and high resolution NMR, Karplus equation, line broadening, chemical exchange, de coupling techniques, shift reagents, Fluxional molecules, Application to structure elucidation of simple organic molecules.

### **UNIT 6: Mass Spectroscopy**

Introduction, basic theory, instrumentation- Mass spectrometer, methods of generation of positively charged ions, mass analysers resolving power, molecular ion peak, base peak, meta-stable peak, modes of fragmentations, McLafferty rearrangement, Retro Diels Alder reaction, ortho effect, Structural elucidation of some organic compounds Negative ions mass spectrometry, determination of appearance potential and ionisation potential, determination of molecular weight and molecular formulae, application of mass spectrometry in qualitative and quantitative analysis.

### **UNIT 7: Flame Photometry and Atomic Absorption Spectroscopy**

Introduction, principle, flames, and flame spectra, variation of emission intensity with flame; metallic spectra in flame, flame background; total consumption and premix burners, role of temperature on absorption, emission and fluorescence, Comparative study of FES and AAS; Interferences: Errors in FES and AAS. Application, Qualitative, and quantitative Determination of alkali and alkaline earth metals and general different samples by FES. Atomic fluorescence, emission spectroscopy, principles and instrumentations.

### **UNIT 8: Luminescence Spectroscopy (Molecular Luminescence)**

Introduction: Fluorescence and Phosphorescence, excited states, Deactivation processes, variables that affect fluorescence and phosphorescence Relationship between the intensity and concentration, Instrumentation: Basic differences in the measurement of fluorescence and phosphorescence; General scope of applications; Comparison of Fluorimetry and Phosphometry. Fluorescent indicators; Applications; Fluorimetric analysis of Inorganic, Organic, Pharmaceutical and biological materials; chemiluminiscence.

### **UNIT 9: ESR spectroscopy**

Basic principles: Interaction between electron spin and magnetic field; Origin of the spectral lines; Intensity, width, and position of spectral lines; Relaxation process; Multiplicity in ESR hyper fine splitting; g-value and factors affecting on it; Rules for interpretation of spectra; zero field splitting and Kramer's degeneracy; John teller distortion; Isotropic and Anisotropic coupling constants; Nuclear quadrupole coupling interaction; spin Hamiltonian; ESR spectra of radicals containing a single set of equivalent protons methyl, p-benzoquinone anion, Cyclopentadienyl, benzene, Cycloheptatrienyl anions; ESR spectra of transition metal complexes; Applications.

### **Reference:**

01.Structural Methods in Inorganic Chemistry – EAV Ebsowth, David, W.H.Rankin and

- Stephen Cradock-Backwell Scientific Publications 2<sup>nd</sup> edition (1999).
02. Introduction to Instrumental Analysis – R.V. Braun McGraw Hill International edition (1987).
  03. Thermal methods – J.W. Dood and Kermeth. H. Tonge, John Wiley and Sons (1987).
  04. Inorganic Thermogravimetric Analysis – E. Duval, Elsevier, 2<sup>nd</sup> edition (1963).
  05. Organic Spectroscopy – V.R. Dani, Tata McGraw Hill Publishing Co., (1965).
  06. Fundamentals of Molecular Spectroscopy – C.N. Banwell-Tata McGraw Hill, (1975).
  07. Molecular Structure and Spectroscopy – G. Aruldas, Prentice Hall India, New Delhi, 2001.
  08. Principles of Instrumental Analysis – Skoog, Holler and Nieman, Harcourt Asia Pvt. Ltd., India, New Delhi. V Ed., 1998.
  09. Fundamentals of Analytical Chemistry – Skoog, West and Holler, Harcourt Asia Pvt. Ltd., India, New Delhi. V Ed., 1998.
  10. Vogel's Textbook of Quantitative Chemical Analysis – G.H. Jaffery, J. Bassett, J. Mendham and R.C. Dinney, ELBS, V Ed., 1996.
  11. Solid State Chemistry and its Applications – A.R. West, John Wiley and Sons, 1984.
  12. Materials Science – G.K. Narula, Tata McGraw Hill Company, 1988.
  13. Introduction to Chromatography – Theory and Practice – V.K. Srivastava and K.K. Srivastava, S. Chand Company Ltd., IV Ed., 1991.
  14. Analytical Chromatography – G.R. Chatwal, Himalaya Publishing House, VII ed., 1998.
  15. Instrumental Methods of Chemical Analysis – B.K. Sharma, Goel Publishing House, Meerut, 2000.
  16. Instrumental Methods Analysis – Willard, Merritt and Dean, VII Ed., 1998.

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## **56772: INORGANIC CHEMISTRY**

### **UNIT 1: d - block elements**

Electronic configuration, general characteristics and correlation with electronic configuration; comparative study of 3d, 4d and 5d elements by taking titanium sub-group as example. Metal carbonyls, 18-electron rule and stability. Preparation, bonding and structures of Ni, Co, Fe and Mn carbonyls.

### **UNIT 2: f - block elements**

Position in the periodic table, f-orbitals and their symmetry aspects. Lanthanides - electronic configuration, oxidation states, lanthanide contraction. Extraction, separation of lanthanides - difficulties - solvent extraction and ion - exchange methods. Complex formation, Coordination Number and stereochemistry, colour, spectra and magnetic properties; lanthanides as shift reagents.

Actinides - electronic configuration, oxidation states, extraction and separation of actinides, spectral and magnetic properties, complexes; comparison with lanthanides and d-block elements.

### **UNIT 3: Co-ordination Chemistry**

Basics of coordination chemistry: Introduction, chelating and bridging type of ligands, macrocyclic ligands, nomenclature and preparation of coordination compounds, types of reactions involved. Isomerism in metal complexes - geometric and optical isomers (C.N. 4 & 6) stability of complexes: stepwise and over-all stability constants. Factors affecting stability the Irving - Williams series. Determination of composition and stability constants by Spectrophotometric methods.

### **UNIT 4: Electronic spectra of complexes**

Spectra of transition metal ions - term symbol of  $d^n$  ions, ground state terms, term splitting in weak crystal fields, inter - electronic repulsion parameters, Orgel and Tanabe-Sugano diagrams. Selection rules and band intensities, charge transfer spectra - LMCT & MLCT. Interpretation of electronic spectra, calculation of  $\Delta$  and B. Spectrochemical series and nephelauxetic series. Spectral properties of divalent 3d metal ion complexes.

#### **UNIT 5: Magnetic properties**

Magnetic susceptibility; types of magnetic behaviours - dia, para, ferro and anti-ferro magnetism; crystal field and M.O. interpretations, Quenching of orbital moment, spin-orbit coupling, spin-cross over; antiferromagnetic coupling.

Experimental aspects - Gouy and Faraday methods. Effect of temperature on magnetic behaviour, magnetic properties and structure. Magnetic properties of lanthanides and actinides. High-spin and low-spin complexes, Magnetic behaviour of Co(II) and Cu(II) complexes.

#### **UNIT 6: Electron transfer reactions**

inner and outer sphere mechanisms, complementary and non-complementary electron transfer reactions.

#### **UNIT 7: Complexes of $\pi$ - acceptor ligands**

Metal carbonyls, preparation, reactions, bonding and structure; EAN rule and structure. nitrosyl compounds.

#### **UNIT 8: M-M Bonding**

Factors affecting metal – metal bonding, metal clusters- binuclear compounds, three atom clusters, four atom tetrahedral clusters, five and six atom clusters.

#### **UNIT 9: Organometallic compounds**

Nomenclature, 16 - and 18 - electron rule, stability, classification of ligands; synthesis, reactions, structure and bonding of olefin, diene,  $\pi$ -cyclopentadienyl and arene complexes: Reactions - addition, elimination, substitution and rearrangement. Fluxional behaviour of organometallics.

#### **UNIT 10: Catalysis involving Org. metallic compounds**

Homogeneous catalysis- hydrogenation of olefins, Oxo - process, Wacker process, Water gas shift reaction, Carbonylation.

Heterogeneous catalysis: Fischer-Tropsch reaction, Ziegler-Natta polymerization.

#### **UNIT 11: Bioinorganic chemistry**

Role of alkali, alkaline earth, Fe, Co and Cu metal ions in biological systems; molecular mechanism of ion transport across membranes - active transport, the sodium / potassium pump,  $\text{Na}^+/\text{K}^+$ -ATPase.

#### **UNIT 12: Metal complexes as oxygen carriers**

Hemoglobin (Hb) and myoglobin (Mb)-structure, stereochemistry and oxygenation of Hb and Mb; cooperativity and Bohr effect.

#### **UNIT 13: Electron carriers - Cytochromes**

Classification - cytochrome C, cytochrome P-450, ferridoxins, redox chemistry of iron - porphyrins.

#### **UNIT 14: Metalloenzymes**

Mechanism of enzyme action; carbonic anhydrase, carboxy peptidase-A, Vit B<sub>12</sub>-coenzyme. Fixation of nitrogen, iron-sulphur proteins, rubredoxin, nitrogenase. Photosynthesis - chlorophyll - PS-I and PS-II.

Metal ion deficiency effects, metal ions toxicity and treatment, metal-nucleic acid interactions, chelating agents in medicine, metal complexes as therapeutic agents and anticancer agents.

### **UNIT 15: Mossbauer Spectroscopy**

Theory, and principles, Experimental methods, Isomer shift, Quadropole interactions, electron density. Magnetic interactions; time and temperature dependent effect, Applications; Iodine trihalides, prussian blue, tri iron do decacarbonyl, tin halides, hexacyano ferrate and nitroprussides.

### **UNIT 16: Nuclear Quadropole Resonance Spectroscopy**

Consequences of nuclear spin larger than ½ prolate and oblate nuclear quadropole charge distributions, Theory and instrumentation, relationship between electric field gradients and molecular structure; applications; The interpretation of eQ. q data. Effects of crystal lattice on the magnitude of eQ. Q. Structural information for NQR spectra.

### **References:**

01. Advanced Inorganic Chemistry, (5<sup>th</sup> edition) – F.A. Corton and G.Wilkinson; John Wiley and Sons. 1988.
02. Inorganic Chemistry: Principles of Structure and Reactivity (3<sup>rd</sup> edition) – James E.Huheey, Ellen E.Keither and Richard L.Keither; Harper Collins college Pub.,1993.
03. Photochemistry of Coordination Compounds-V.Balzari and V.Carassiti, Academic press.
04. Fundamentals of Photochemistry – K.K. Rohatgi Mukherji, Wiley Eastren.
05. Symmetry and Spectroscopy of Molecules – K.Veera Reddy, New age Int.Pub.1998.
06. Concise coordination Chemistry-R.Gopalan & V.Ramalingam, Vikas Pub., New Delhi, 2001.
07. Organometallic Chemistry: A Unified Approach – R.C. Mehrotra and A.Singh: Wiley Eastern, New Delhi.
08. Coordination Chemistry – F.Basalo and R.C.Johnson; W.A. Benjamin Inc., 1979.
09. Coordination Chemistry – S.F.A.Kettle.
10. Principles of Bioinorganic Chemistry-S.J.Lippard and J.M.Berg, University Sci. Books.
11. Principles and applications of Organo transition metal Chemistry-J.P.Collman, L.S.Hegsdus. J.R. Norton and F.G.Finke, University Sci. Books.

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## **56773: ORGANIC CHEMISTRY**

### **UNIT 1: Photochemistry**

Bonding and antibonding orbitals, Symmetry of orbitals, Singlet and triplet states. Relative energies of excited states. Jablonski diagram.

Norrish Type –I and Norrish Type- II reactions. Paterno- Buchi reaction, di-pi rearrangement , photoisomerisation and photoreduction.

### **UNIT 2: Pericyclic Reactions**

Classification of pericyclic reactions. Woodward-Hoffmann Rules. FMO and PMO approach to the following reactions:- Electrocyclic, Cycloaddition and Sigmatropic rearrangements.

### **UNIT 3: Molecular Rearrangements**

Classification and general mechanistic treatment of nucleophilic, electrophilic and free radical rearrangements. Mechanism of Wagner-Meerwein, Pinacol-Pinacolone, benzil-benzilic acid, Fries, Wolf, Cope, Beckmann, Hoffmann, Lossen, Curtius, Schmidt and Claisen rearrangements.

#### **UNIT 4: Spectroscopy**

Application of IR, UV-Visible, NMR spectroscopy in structural elucidation of organic compounds. Problems structural elucidation involving all the above spectroscopic techniques.

#### **UNIT 5: Named Reactions:**

Stork enamine, Mannich, Sharpless, Barton, Chichibabin, Perkin, Stobbe, Reimer-Tiemann, Friedel Craft, Michael addition, Oppenauer oxidation, Wolf-Kishner reduction, Diel-Alder reaction, Wittig reaction and Birch reduction.

#### **UNIT 6: Natural Products**

**Nucleic Acids:** Classification, components of nucleic acids, Structure and synthesis of Nucleosides and nucleotides. Crick –Watson model of DNA. m-RNA, t-RNA and r-RNA. Role of DNA and RNAs in protein synthesis. Genetic code.

**Alkaloids:** General methods of structural elucidation – Morphine and Quinine.

**Terpens:** Classification and general methods of structural elucidation – Menthol and Zingiberin.

#### **References:**

1. Advanced Organic Chemistry by Jerry March John Wiley & Sons.
2. Organic Chemistry by Sehan Ege D.C. Heath & Company.
3. Organic Chemistry Vol I & II By I.L.Finar, ELBS & Longman.
4. A Guide Book to Mechanism in Organic Chemistry By Peter Sykes Orient Longman.
5. Stereochemistry of Organic Compounds By D. Nasipuri New Age International (P) Ltd.
6. Organic Chemistry By P.Y. Bruice, Prentice Hall International.
7. Heterocyclic Chemistry By Joule and Smith, ELBS.
8. Heterocyclic Chemistry R.K.Bansal, New Age International (P) Ltd.
9. Organic Chemistry By Morrison and Boyd, Prentice Hall International.
10. Vogel's Text Book of Practical Organic Chemistry, By Furniss, Hannaford, Smith and Tatchell ELBS Longman.
11. Organic Chemistry H.Pine, Hendrickson, Cram and Hammand Mac Graw Hill.
12. Stereochemistry of Organic Compounds By E.L.Eliel John Wiley & Sons.
13. Advance Organic Chemistry Part A & B By F.A. Carey and Sundberg Plenum Press.
14. Advanced General Organic Chemistry By S.K. Ghosh Book & Allied (P) Ltd.
15. Reactive intermediates in Organic Chemistry By N.S. Issacs John Wiley & Sons.
16. Advance Practical Organic Chemistry N.K.Vishnoi Vikas Publication House Pvt. Ltd.
17. Named and Miscellaneous reactions in Practical Organic Chemistry By R.J.W.Cremlyn Heinemann Educational Books Pvt. Ltd.
18. Chemistry of Natural Products By Chatwal.
19. Organic reaction Mechanism By Gurdeep

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### **56774: PHYSICAL CHEMISTRY**

#### **UNIT 1: Thermal methods of analysis**

Introduction, Thermogravimetric analysis (TGA), types of thermogravimetric analysis, principle and method. Automatic thermogravimetric analysis, instrumentation, types of recording thermobalances, sample holders, factors influencing thermograms and application. Isothermal

analysis. Differential thermal analysis (DTA), principle of working, theory and instrumentation. Simultaneous DTA-TGA curves, factors affecting results and applications; Differential scanning calorimetry (DSC). Principles of working, theory, instrumentation and applications. Thermometric titrations.

### **UNIT 2: Kinetics and mechanism of reactions**

Inert and labile complexes; legand displacement (substitution) reactions in octahedral Co(III) complexes, base hydrolysis of Cr (III) complexes, ligand displacement in square - planar Pt(II) complexes, trans effect.

### **UNIT 3: Nuclear and Radiation chemistry**

Nuclear size, Nuclear forces, Packing fraction, Nuclear density, Mass defect, Binding energy of the nucleus, Binding energies and stability of nuclei, Nuclear models, Nuclear shell model, The liquid drop model, The collective model, Nuclear fission, Calculation of energy released in nuclear fission, Liquid drop model and nuclear fission, The fission chain reaction. The concept of critical mass, Release of fission energy, Nuclear fusion, Hydrogen bomb.

### **UNIT 4: Radiation Chemistry**

Radiolysis of water, Hydrated electron, Radiolysis of some aqueous solutions, Radiation dosimetry, Dosimeters (Fricke and Ceric sulphate).

### **UNIT 5: The Second law of Thermodynamics**

Limitations of the First law of thermodynamics; need for second law, spontaneous processes, Cyclic processes, Carnot cycle, Second law of thermodynamics, Efficiency of heat engine, Carnot's theorem, Concept of entropy, Entropy change in isothermal expansion of an ideal gas, Entropy changes in reversible and irreversible processes, Statement of second law, Entropy change accompanying change of phase, Calculation of entropy changes of an ideal gas with change in P, V and T, Entropy of mixture of ideal gases, Entropy of mixing, Entropy change in chemical reactions, Standard entropies, Physical significance of entropy, Work and free energy functions, Criteria for reversible and irreversible processes, Third law of thermodynamics.

### **UNIT 6: Macromolecules**

Macromolecules, Polyethylene, Degree of polymerization, Classification of polymers, Isotactic polymers, Atactic polymers, Syndiotactic polymers, Stereoregular polymers, Graft polymers, Polymerization reactions, Nylon, Terylene, Molar masses of polymers, Number-average molar mass, Weight-average molar mass, Determination of molar masses of macromolecules - Viscosity method, Osmotic pressure method, Ultracentrifugation, Sedimentation velocity method, Light scattering by macromolecules.

### **UNIT 7: Spectroscopy**

Spectroscopy, Molecular spectra, Various types of spectra, Massbauer spectra, Rotational or microwave spectra, Relative intensities of rotational spectral lines, Vibrational spectra, Force constant, Zero point energy, Fundamental vibrational frequency, Anharmonicity constant, Rotation-vibration spectra, Infrared spectra, Vibrations of polyatomic molecules, Overtones and combination bands, Raman spectroscopy

### **UNIT 8: IR and Raman Spectroscopy**

Theory of IR absorption, types of vibrations, theoretical number of fundamental modes of vibrations and group frequencies, factors affecting group frequencies and band shapes, physical states of the sample, vibrational coupling, electrical effect, inductive effects, hydrogen bonding



and ring structure - Instrumentation -, FTIR instrument and its advantages, sample handling techniques, qualitative applications of IR - Correlation charts, important regions in IR. Applications to structural elucidation of simple organic molecules; Applications of IR spectroscopy to coordination compounds, organo transition metal complexes, (N-N dimethyl acetamide, urea, thiourea, DMSO,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_2^-$ ). Far IR spectroscopy-effects of coordination and symmetry of donor molecules. Basic principles of Raman spectroscopy and its relationship to IR.

#### Reference:

- 1.Principles of Physical Chemistry Puri, Sharma & Pathania, S. N. Chand & Co.,1996.
- 2.Advanced Physical Chemistry, Gurudeep Raj, Electrochemistry, B.K. Sharma.
- 3.Physical Chemistry, Atkins, ELBS, 1982.
- 4.An Introduction to Chemical Thermodynamics R.P. Rastogi and S.S. Misra, Vikash Publications, New Delhi, 1978.
- 5.Essentials of Nuclear Chemistry, H.J. Arnikar, IV Edition, New Age International (P) Ltd., 1994.
- 6.Physical Chemistry, K.J. Laidler and J.H. Meiser, II Edition, II Edition, II Edition, CBS Publishers and Distributors, 1999.
- 7.Textbook of Physical Chemistry, S. Glasstone, II Edition, Macmillan India, 1974.
- 8.Introduction to Quantum Chemistry, Chandra, Tata McGraw Hill, New Delhi.
- 9.Quantum Chemistry, R.K. Prasad, II edition, New Age Int., 2000.

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#### PRACTICAL-IV: INORGANIC CHEMISTRY

01. Preparation of co-ordination compounds  
 $\text{Hg}[\text{Co}(\text{SCN})_4]$ ,  $\text{Ni}(\text{DMG})_2$ ,  $\text{Mn}(\text{acac})_3$ ,  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ ,  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ ,  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ .
02. Analysis of Co-ordination compounds for metal and ligand contents  
 (i) Fe and  $\text{C}_2\text{O}_4$  in  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$   
 (ii) Co and Cl in  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ .
03. Determination of Ionisable Cl from complexes.
04. Determination of composition of complexes.
05. Determination of stability constants.
06. Conductance measurement for complexes.
07. Determination of magnetic susceptibility of paramagnetic materials by using Guoy magnetic balance.
08. Recording electronic spectra of complexes: interpretation and assignment of bands.
09. Recording IR spectra of ligands and complexes and interpretation.
10. Determination of uranium by extractive spectrophotometry.
11. Separation of Ni, Mn, Co and Zn by TLC.
12. Paper chromatography-Separation of Fe and Ni; Cu and Ni.
13. Potentiometric titration; Cu vs EDTA.
14. Determination of iron in mustard seeds by colorimetric method.
15. Determination of phosphate in peas by colorimetric method.

#### References:

01. Quantitative Chemical Analysis – I.M.Kolthoff, E.B.Sandell, E.J.Meehan and S.Bruckenstein, Mac Millan Company, 1968.
02. Vogel's Textbook of Quantitative Chemical Analysis – G.H.Jeffery, J.Bassett.J. Mendham and R.C. Denney, ELBS, Longman, 5<sup>th</sup> Ed., 1989.

03. Advanced Practical Inorganic Chemistry-Gurdeep Raj, Goel Publishing House, 10<sup>th</sup> Ed., 1994.
04. A Text Book of Quantitative Inorganic Analysis – A.I.Vogel, ELBS, Longman, 3<sup>rd</sup> Ed.,1961.
05. Quantitative Analysis – R.A. Day and A.L. Underwood, Prentice Hall of India Pvt. Ltd., 1993.
06. Concise Coordination Chemistry-R.Gopalan and V.Ramalingam, Vikas Publishing House Pvt. Ltd., 2001.

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### PRACTICAL -V: ORGANIC CHEMISTRY

#### Qualitative Analysis:

Separation of organic binary mixture (Solid + Liquid), identification of components and preparation of derivative.

#### Preparations:

Two step preparations.

#### Estimations:

Estimation of Aniline, Estimation of Phenol, Estimation of Glucose, Estimation of Cholestreol, Estimation of amino acid. Saponification value of soaps. Estimation of Amides and Esters.

#### References:

01. Vogel's Text Book of Practical Organic Chemistry, By Furniss, Hannaford, Smith and Tatchell ELBS Longmann.
02. Advanced Practical Organic Chemistry By N.K. Vishnoi, Vikas Publishing House
03. Handbook of Practical Organic Chemistry By Clark
04. Practical Organic Chemistry By Agrawal.

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### Practical-VI: PHYSICAL Chemistry

#### A. Conductometric titrations

1. Strong acid  $\gg$  Strong base (HCl  $\gg$  NaOH)
2. Weak acid  $\gg$  Strong base (CH<sub>3</sub>COOH  $\gg$  NaOH)
3. (Strong acid + Weak acid)  $\gg$  Strong base [(HCl + CH<sub>3</sub>COOH)  $\gg$  NaOH]

#### B. Conductometric titrations of polybasic acids

1. Oxalic acid  $\gg$  NaOH
2. Phosphoric acid  $\gg$  NaOH

#### C. *pH* and *pKa* values of weak acids by conductometric method

1. Acetic acid (CH<sub>3</sub>COOH)
2. Formic acid (HCOOH)

#### D. Potentiometric titrations

1. Fe(II)  $\gg$  Mn(VII)
2. Fe(II)  $\gg$  Cr(VI)

#### E. Potentiometric titrations of polybasic acids

1. Oxalic acid

## 2. Phosphoric acid

### **F. pH titrations**

1. Strong acid >< Strong base (HCl >< NaOH)
2. Weak acid >< Strong base (CH<sub>3</sub>COOH >< NaOH)
3. Precipitation titration (CuSO<sub>4</sub> >< NaOH)

### **G. Spectrophotometry**

1. Verification of Beer's – Lambert's law
2. Determination of unknown concentration of KMnO<sub>4</sub>.

### **References**

1. Experiments in Physical Chemistry J.C. Ghosh, Bharati Bhawan Publishers and Distributors, Patna, 1988.
2. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House, Meerut, 1993.
3. Vogel's Textbook of Quantitative Chemical Analysis, G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney, V Edition, ELBS Publication, 1989.
4. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill Publishing Co. Ltd.
5. Findley's Physical Chemistry, J.B. Levitt, Longman Publications.

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