

# PROGRAMME PROJECT REPORT (PPR)

**Name of the Programme:**     **MASTER OF SCIENCE IN APPLIED CHEMISTRY  
(M.Sc. Applied 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 Applied Chemistry enabling them to take up careers mainly in industry and also in academic or 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 applied 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/applied 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 applied chemistry for individuals who are currently employed, in chemistry-related industrial sector 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 applied 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 Applied Chemistry Programme, is intended for the target group of senior secondary level Classes (XI- XII) Teachers who look for industrial based knowledge enhancement and carrier development. Learners who wish to build their carriers in technical positions in places such as the chemical industry, government laboratories, or regulatory agencies are our targets. And also analytical scientists in a wide range of industries including drug, pharmaceutical, oil, food and drink, chemical safety officer, lab chemist, chemical oceanographer, chemical instrument technician, 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 Applied 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 Applied 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 applied chemistry concepts 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	IA Continuous Evaluation	Term End Exam	Total
Previous Year	Course 1: Analytical and Spectroscopic Techniques	15	85	100
	Course 2: Inorganic Chemistry	15	85	100
	Course 3: Organic Chemistry	15	85	100
	Course 4: Physical Chemistry	15	85	100
	Applied Chemistry Practical-I	* 20	55	75
	Applied Chemistry Practical-II	* 20	55	75
	Applied Chemistry Practical-III	* 20	55	75
	<b>Total marks</b>	<b>120</b>	<b>505</b>	<b>625</b>
Final Year	Course 1: Advanced Inorganic Chemistry	15	85	100
	Course 2: Bio-Organic and Medicinal Chemistry	15	85	100
	Course 3: Polymer Chemistry and Technology	15	85	100
	Course 4: Selected Topics in Industrial Chemistry	15	85	100
	Applied Chemistry Practical-IV	* 20	55	75
	Applied Chemistry Practical-V	* 20	55	75
	Applied 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. degree with chemistry/Industrial chemistry/Applied chemistry as an optional/major subject or B.E/ B.Tech. in Chemistry/ B.Sc. Agri./ B.Sc. Home Science or any degree in Science having Chemistry/Applied chemistry as optional subject 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 Applied 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 alongwith 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 2016-17

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>

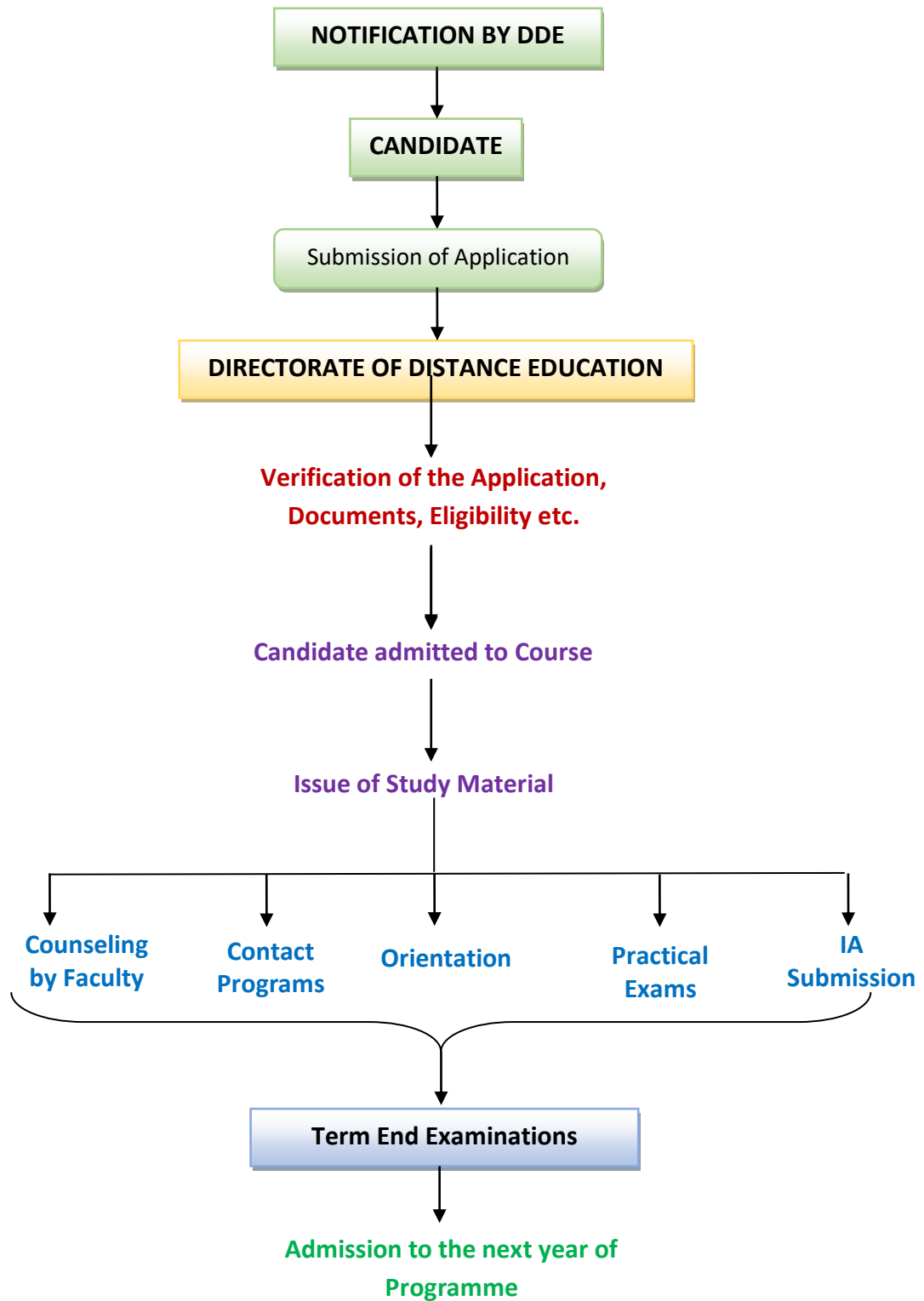
**Financial Assistance:**

- 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

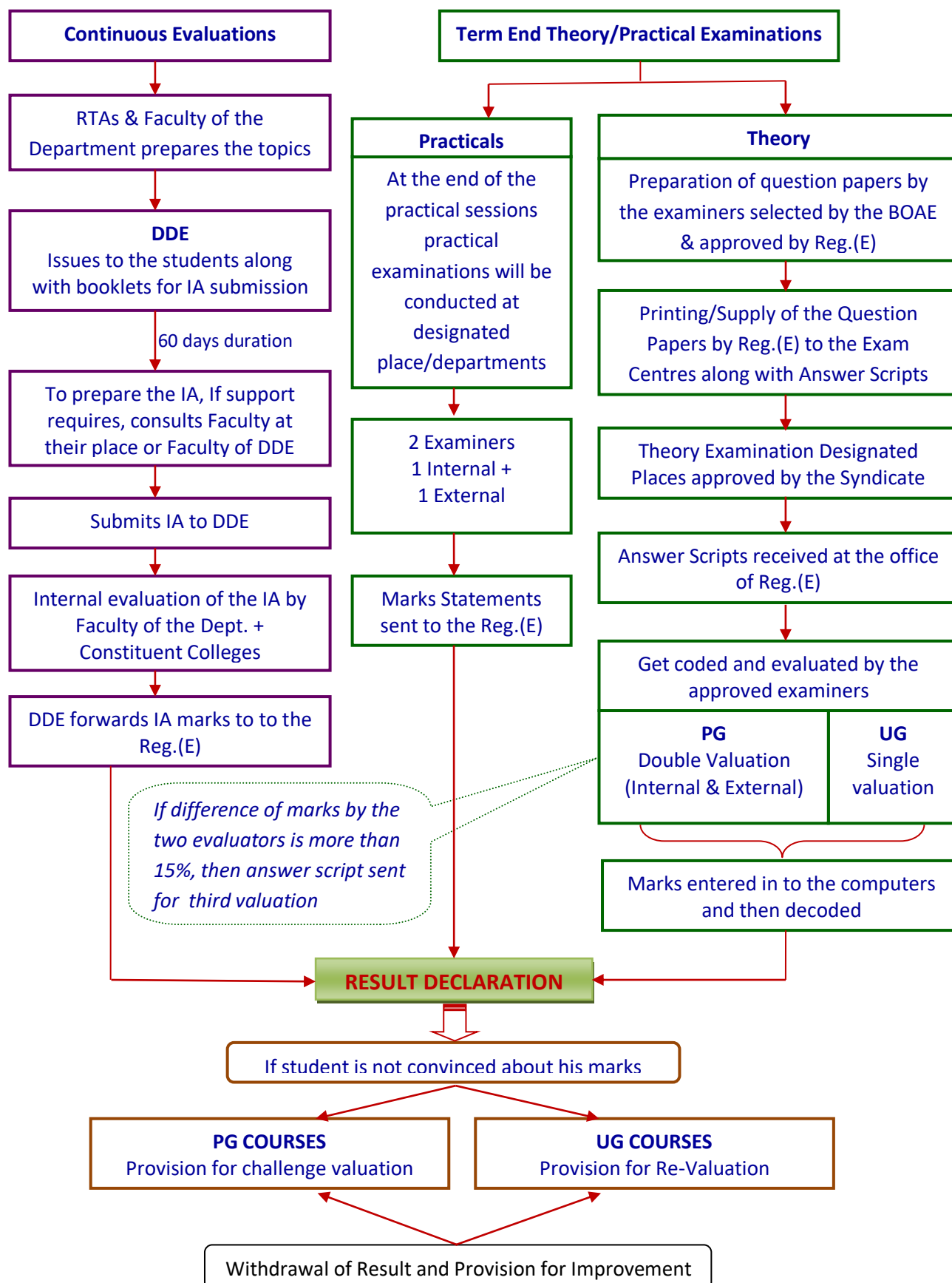
## Generalised Academic Flow Chart for the Distance Mode Learners





## (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 Centres.
- 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	Eleven very short answer type with internal choice	11x2	22
Part-B	Four long answer type with internal choice	4x8	32
Part-C	Two long answer type with internal choice	2x13	26
Part-D	One short answer type with internal choice	1x5	05
Total			85

### Practicals:

- For M.Sc. Applied Chemistry Programme, the candidates will have to attend practical sessions for specified days at designated University Departments / Colleges/ Student Counseling Centres.
- For M.Sc. Applied 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 papers/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 duration 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 with in the maximum permissible period ie., 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:

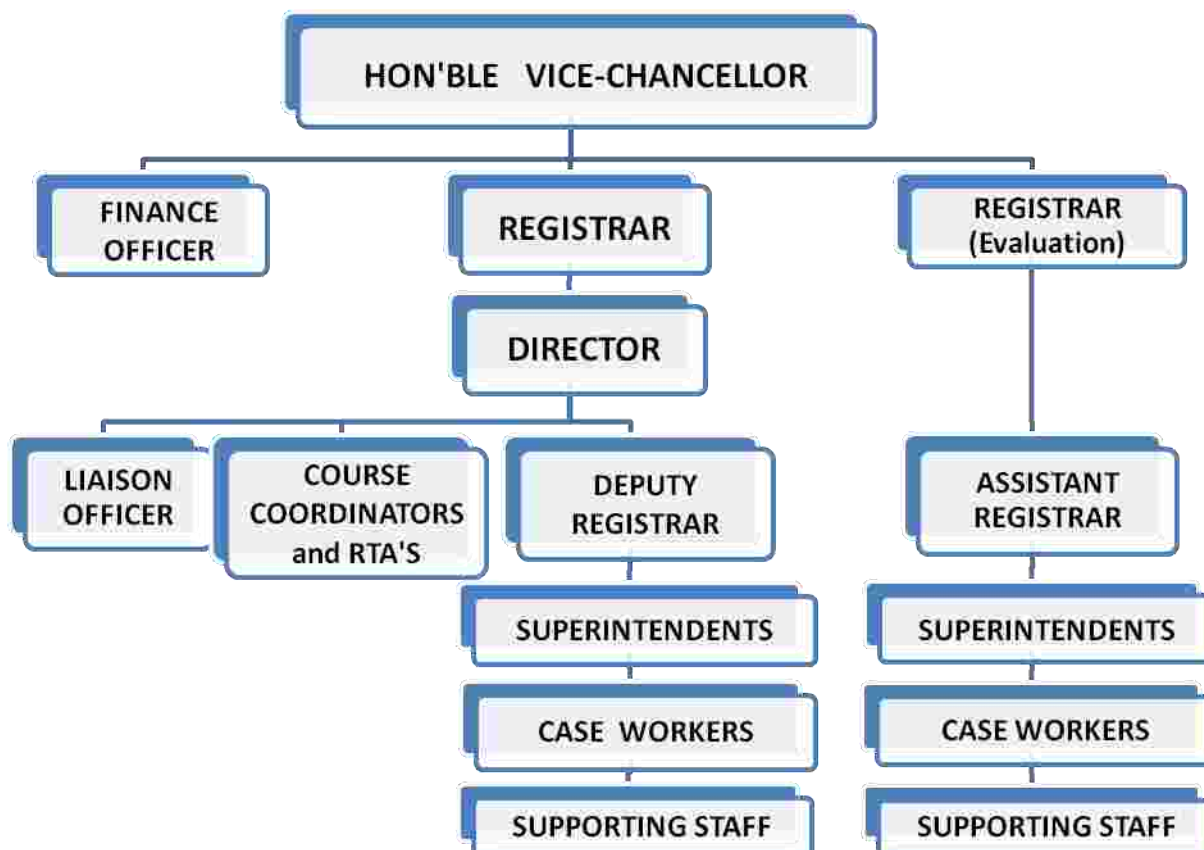
SN	Component	Estimate ( Lakh in Rupees)
1	Study Material Development – Course Writer honorarium, Review vetting, editing, SLM conversion etc	6.00
2	Printing and Distribution of SLM	5.54
3	Publicity, Awareness Information Decimation Programmes*	0.20
4	Conduction of Counselling, Orientation/Face to Face/ 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
13	Learner Centre Expenses*	0.36
14	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 Organising 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.

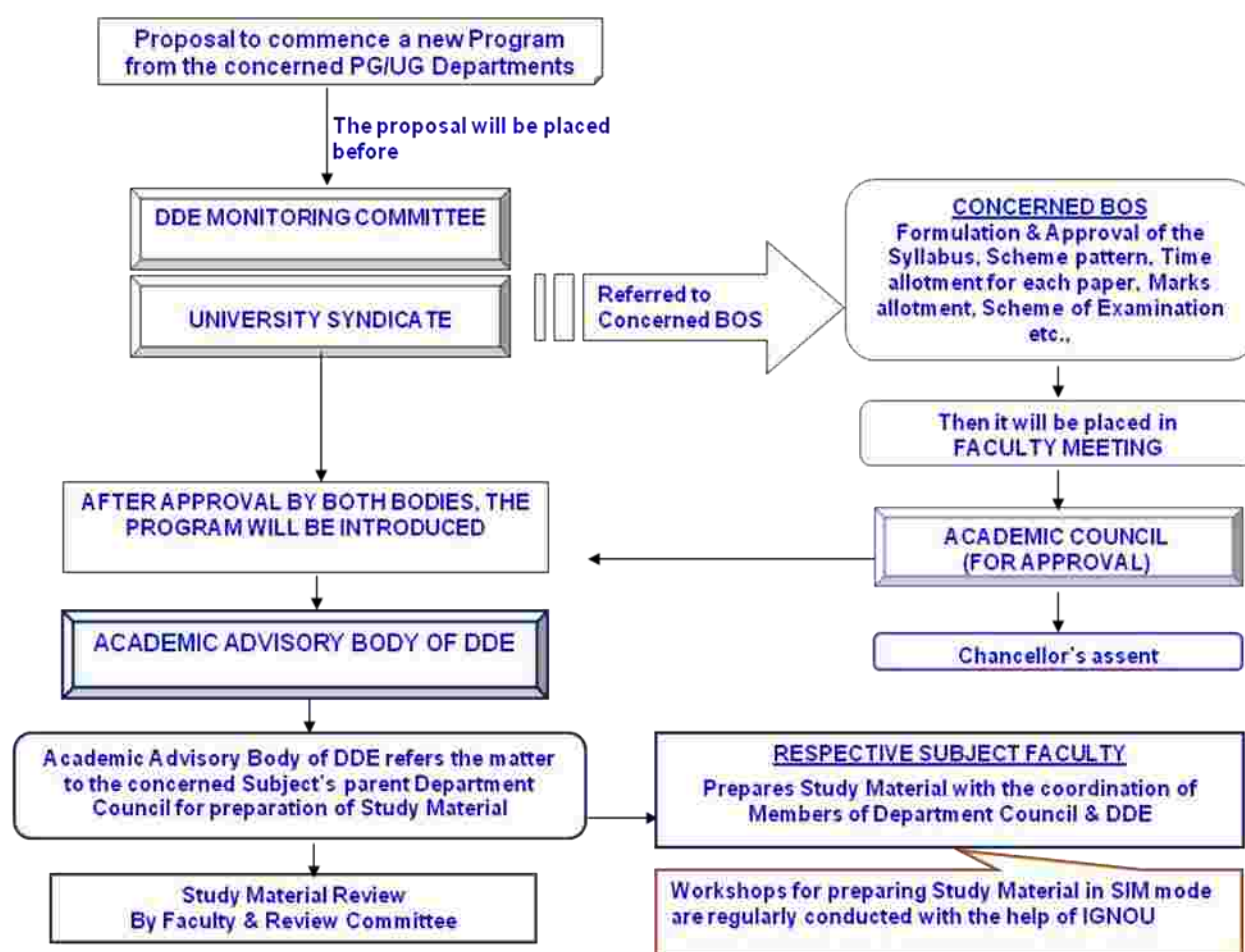
The decisions taken by the AAC are placed through the concerned bodies like, BOS/ Examination wing (for evaluation and certification issues) and finally placed before the Academic Council of the University for its approval.

For the internal quality assurance mechanism there is an 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 Centres (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 Applied Chemistry Programme.**  
**FIRST YEAR – M. SC. PREVIOUS (THEORY AND PRACTICAL)**

**DEC.APP.CHEM. 1.01: Analytical and Spectroscopic Techniques**

**Unit 1: Basic tools and operations of analytical chemistry :** Data handling and interpretation of results, Statistics of small data sets, plotting of calibration curves good laboratory practice, quality assurance of analytical measurements stoichiometric calculations.

**Unit 2: Spectrochemical methods:** Nature and interaction of electromagnetic radiation with matter, energies corresponding to various kinds of radiations, atomic and molecular transitions, selection rules, factors influencing positions and intensity of spectral lines.

**Unit 3: UV-visible spectroscopy :** Beer-Lambert laws and its limitations, terminology associated with electronic spectroscopy, types of absorption bands and the oritical interpretation, effect of solvent and structure of Xmax, Woodward-Fieser rule.

**Unit 4: Infra Red Spectroscopy:** Theory of IR absorption Instrumentation, sample handling techniques, qualitative applications of IR, Applications to structural elucidation of simple organic molecules. Applications of IR spectroscopy to co-ordination compounds, organic transition metal complexes (N-N dimethyl acetamide, urea, thioures, DMSO, NO<sub>3</sub> SO<sub>4</sub><sup>2-</sup>, NO<sub>2</sub>).

**Unit 5: Fluometry:** Priniciples of fluorescene, chemical structure and fluorescence, fluorescene quenching, relationship between concentration and fluorescene intensity.

**Unit 6: Atomic spectrophotometric methods:** Flame emission spectrometry, principle, applications and instrumentation.

**Unit 7: Atomic absorption spectrophotometry:** Principle, instrumentation, sample preparation, and applications.

**Unit 8: Chromatography:** Classification, basic principle, theory of chromatography, ion-exchange chromatography, ion-exchange process, synthesis and structure of ion-exchange resins, resolution, retention parameters, selectivity ion-exchange capacity, application in the removal of interfering ions, lanthanide separation, concentration and recovery of tracer ions.

**Unit 9: Gas Chromatography:** Characteristic of mobile stationary phase used in GSC and GLC, characteristics of carrier gases, detectors, TCD, FID and ECD, applications of GC and GC- Ms.

**Unit 10: Paper and Thin layer chromatography:** Stationary and mobile phases, various techniques of development-visualization and evolution of chromotograms, applications, separation of inorganic and organic compounds.

**Unit 11: High performance liquid chromatography:** Scope of HPLC, introduction principle-instrumentation detectors and applications.

**Advanced instrumental methods :**

**Unit 12: Nuclear Magnetic Resonance (NMR) Spectroscopy :**

Types of nuclei, theory of population of nuclear 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, decoupling techniques, shift reagents, Fluxional molecules, application to structure elucidation of simple organic molecules.

**Unit 13: Mass Spectroscopy:** Introduction, basic theory Mass spectrometer McLafferty rearrangement, Retro Diels Alder reaction, ortho effect application of mass spectroscopy in qualitative and quantitative analysis.

**Unit 14: ESR Spectroscopy:** Basis principles theory of ESR spectra, experimental techniques, 'g' factor, significance; multiplicity in ESR hyper fine splitting; rules for interpretation of spectra, Zero field splitting and Kramer's degeneracy: John Teller distortion; isotropic and Anisotropic coupling constants; Nuclear quadrupole coupling interactions, applications of ESR to simple inorganic and organic compounds.

**Unit 15: Thermal methods of analysis :** Basic theory and working principles of thermo gravimetric analysis (TGA), differential thermal analysis (DTA) and Differential scanning calorimetry (DSC). Applications of TGA, DTA and DSC with special reference to characterization of inorganic and organic complexes and polymeric materials.

#### **References:**

1. Principles of Quantitative Chemical Analysis - Robert de Levie, International edition 1997 McGraw Hill Co.
2. Quantitative Analysis - Day and Underwood, Printice Hall Indian, Pvt. Ltd. 6th edition (1993).
3. Vogel's Textbook of Quantitative Chemical Analysis - Revised by G.H. Jaffery, J. Bassett, J. Mendham and R.C. Denney, ELBS 5th edition (1998).
4. Spectroscopy of Organic Compounds - P.S. Kalasi Wiley Eastern Ltd., India, 1993.
5. Organic Spectroscopy-William Kemp, 3rd edition ELBS (1991).
6. Quantitative Chemical Analysis-D.C. Harris, W.M. Freeman and Co., NY, USA, IV Ed, 1995.
7. Introduction to Instrumental Analysis-RD.Braun, McGraw Hill Book Company, 1982.
8. Fundamentals of Molecular Spectroscopy-C.N. Banwell, Tata McGraw Hill Book Company, 1973.
9. Physical Methods in Inorganic Chemistry-R. Drago, Affiliated to East West Pvt. Ltd., 1968.
10. Introduction to Chromatography-Theory and Practice - V.K.Srivastava and K.K. Srivastava, S. Chand Company Ltd., IV ed., 1991.
11. Analytical Chromatography-G.R. Chatwal, Himalaya Publishing House, VII ed., 1998.
12. Basic Concepts of Analytical Chemistry-S.M. Khopkar, New Age International Publishers, India, 1998.
13. Molecular Structure and Spectroscopy-G. A. Ruldas, Prentice Hall India, New Delhi, 2001.
14. Principles of Instrumental Analysis-Skoog, Holler and Nieman, Harcourt, Asia Pvt. Ltd., India, New Delhi, V Ed., 1998.
15. Fundamentals of Analytical Chemistry-Skoog, West and Holler, Harcourt, Asia Pvt. Ltd., India, New Delhi, VII Ed., 1998.

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## **DEC.APP.CHEM. 1.02: INORGANIC CHEMISTRY**

### **Unit 1: Chemical Bonding**

**Ionic bond**-properties of ionic compounds, close-packing in ionic compounds, radius ratio rule; types and structure of simple ionic compounds (NaCl, CsCl, CaF<sub>2</sub>, TiO<sub>2</sub>, perovskites and spinels); Lattice energy, Born - Lande equation. Born - Haber cycle - applications. Covalent

character in ionic bonds, Fajan's rules, percent ionic character and electronegativity values. Hydration energy and solubility of ionic solids.

**Covalent bond** - Molecular Orbital Theory- LCAO method sigma, pi and delta M.Os.M.O.treatment of Homo and hetero diatomic molecules MOT of delocalised A-bonding systems- CO<sub>2</sub>, NO<sub>2</sub>.

**Unit 2: Shapes of Poly Atomic Molecules** : Application of VSEPR theory and geometry of covalent molecules. Role of p-and d-orbitals in sigma and pi-bonding in non-metallic compounds.

**Pseudo Halogens** : Cyanogen, thiocyanogen and selenocyanogen - preparation and properties.

**Noble Gas Compounds** : Reactivity trends, compounds of xenon (XeF<sub>2</sub>, XeF<sub>4</sub>, XeF<sub>6</sub>, XeOF<sub>2</sub>, XeOF<sub>4</sub>) and krypton (KrF<sub>2</sub>)- Preparation reactions and structures.

**Unit 3: Solid State Chemistry**: Defects in solid - types of defects, stoichiometric defects - Schottky and Frenkel defects, non- stoichiometric defects, colourcentres.

**Band Theory of Solids**: Metals, insulators and semiconductors; intrinsic & Photo excited and impurity & defect semiconductors; Mixed oxides - spinels and perovskites, p-n junctions, high temperature super conductors.

**Organic Solids**: Conjugated systems - doped poly acetylenes, polyparaphenylenes and polypyrroles.

**Unit 4: X-Ray Diffraction Techniques** : Origin and production of X-rays, interaction of X-rays with matter, crystal structure, unit cell, lattices, planes, Miller indices, Bragg's law, X-ray diffraction methods, polymer characterization and applications. Neutron and electron diffraction-basic theory and applications.

**Unit 5: Inorganic Rings, Cages and Polymers**: Chemistry of boranes, carboranes - preparation, chemistry, structure and bonding, S-N compounds (SN)-preparation, properties, structure and bonding. P-N compounds: phosphazenes - trimmer, preparation, structure and bonding. B.N. compounds: borazine - preparation, properties structure and bonding. Silicon polymers - preparation, properties, structures, bonding and applications. Silicates and zeolites - types, structure and applications.

**Unit 6: Transition Elements**: Characteristic properties, correlation with electronic configuration, 3d, 4d, 5d, series, trends in their chemistry.

**Unit 7: Lanthanides and actinides**: Electronic configurations, stable oxidation states, lanthanide and actinide contraction, separation difficulties, ion-exchange separation of lanthanides, absorption spectra, magnetic properties, complexes, comparison with d-block elements.

**Unit 8: Co-ordination Chemistry**: Introduction, chelating and bridging type of ligands, macrocyclic ligands, nomenclature.

**Preparation of Co-ordination Compounds** : Direct reactions - substitution, oxidation, reduction, photochemical, thermal decomposition and electrochemical methods.

**Detection Methods** :Colour change, conduction, pH, solubility, precipitate formation and magnetic methods.

**Stability of Co-ordination Complexes** : Thermodynamic and kinetic stability; stability constants - stepwise (K<sub>n</sub>) and overall stability (B<sub>n</sub>) constants, trends in K<sub>n</sub>, relation between K<sub>n</sub>

and Bn. Factors affecting stability, Irving - William series.

**Determination of Composition** : Jobs method, mole ratio method, determination of stability constants: Spectrophotometric method.

**Isomerism in Metal Complexes** : Structural-Isomerism- Ionisation, co-ordination, linkage, solvate (hydrate), ligand and polymerisation isomerism.

**Stereoisomerism** : Geometrical (cis-trans), optical isomerism: optical isomerism in co-ordination No. 4 and 6.

**Unit 9: Theories of Acids and Bases** : HSAB concept, basis of HSAB concept, acid-base strength and hardness & softness: symbiosis; applications of HSAB concept.

#### **Unit 10: Environmental Chemistry:**

Atmosphere: Segments and temperature distribution.

**Air Pollution** : Types of pollutants - particular matter, SO<sub>x</sub>, NO<sub>x</sub>, CO<sub>x</sub>, H<sub>2</sub>S, CFCs - sources and effects on vegetation, materials and health; photochemical smog, fog, green house effect, acid rain; ozone layer and ozone layer depletion.

Water pollution - Inorganic, organic, pesticide, detergents, oil spills, and domestic sewage, Determination of BOD, COD, DO, As, Cd, Hg, Pb, residual chloride, chlorine demand.

#### **References:**

1. Advanced Inorganic Chemistry, (5th edition)- F.A. Cotton and G Wilkinson; John Wiley and Sons, 1988.
2. Inorganic Chemistry: Principles of Structure and Reactivity (3rd edition)- James E. Huheey, Ellen E. Keither and Richard L. Keither: Harper Collins College Pub., 1993.
3. Theoretical Inorganic Chemistry (2nd edition)-M.C.Day, Jr and J. Selbin; Affiliated East-West Press, New Delhi.
4. Concepts and Models in Inorganic Chemistry(2<sup>nd</sup> edition)-Douglas, McDaniel and Alexander.
5. Concise Inorganic Chemistry-J.D.Lee; ELBS, 1991.
6. Modern Aspects of Inorganic Chemistry- H.J.Emeleus and A.G.Sharpe, ELBS
7. Chemistry of Elements – Greenwood and Earnshaw; Pergoman Press, Oxford, 1986.
8. Chemical Approaches to the synthesis of Inorganic Materials – C.N.R.Rao, Wiley Eastern Ltd.
9. Solid State Chemistry and its Applications – Antony R. West: John Wiley & Sons.
10. Modern Inorganic Chemistry – W.L.Jolly, McGraw Hill, New York, 1984.
11. Environmental Chemistry – A.K. De, Wiley Eastern
12. Environmental Pollution Analysis – S.M. Khopkar, Wiley Eastern.

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### **DEC.APP.CHEM.1.03: ORGANIC CHEMISTRY**

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

Terminology and classification of reagents and reactions. Formation, stability and Structure of Carbocation, Carbanion, free radicals, Carbenes, nitrenes and arynes. Nucleophilic, electrophilic, radical substitution, addition and elimination reactions given by these intermediates. Non-Classical carbocations.

#### **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.

Conformational analysis of simple cyclic (chair and boat forms of cyclohexane) and acyclic systems (butane and 1,2-dichloroethane).

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 ( $S_N1$ ,  $S_N2$  and  $S_Ni$  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 of cyclopropylcation, cyclopentadienyl anion, tropylium cation, annulenes, heteroannulenes and fullerenes [C<sub>60</sub>].

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

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

### **UNIT 6: Addition and Elimination Reactions**

Addition to Carbon-Carbon multiple bonds: Addition reactions involving electrophiles, nucleophiles and free radicals. Cyclic mechanism, orientation and stereochemistry of addition of halogen, hydrogen halide. Addition to carbon-hetero atom multiple bonds. Electrophilic, nucleophilic and free radical addition to C=O and C=N systems.

Discussion of  $E_1$ ,  $E_2$  and  $E_1CB$  mechanisms, Orientation during elimination reactions, Saytzeff and Hoffmann rules. Chugave reaction. Hofmann degradation.

### **UNIT 7: Heterocyclic Compounds:**

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

### **UNIT 8: Organic Acids and Bases**

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

### **UNIT 9: Natural Products I**

#### **Carbohydrates**

**Monosaccharides**; Configuration and conformation of monosaccharides- glucose fructose and mannose. Anomeric effect, Hudson's rule. **Oligosaccharides**; Elucidation of structures of maltose and sucrose. **Polysaccharides** - Structure of Starch, Cellulose, Polysaccharides as source of energy and structural materials. Industrial application of polysaccharides.

### **UNIT 10: Natural Products II**

**Proteins and Nucleic Acids**: Amino acids- Classification, structure, methods of synthesis and properties. Synthesis of polypeptides – uses of blocking agents. Bruce-Meerfield synthesis of

polypeptides. Structure of proteins- End group analysis Primary, secondary, tertiary and quaternary. Biological importance of proteins.

### **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. A Guide to Mechanism in Organic Chemistry- By Peter Sykes, Longmann.
04. Structure and Mechanism in Organic Chemistry – By C.K. Ingold, Carnel University Press.
05. Organic Chemistry by R.T. Robinson and R.N. Boyed, Prentice-Hall.
06. Modern Organic Reactions, by H.O. House, Benjamin.
07. Principles of Organic Synthesis. By R.O.C. Norman and J.M. Coxon. Blackie Academic & Professional.
08. Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P. Singh, MacMillan (India).
09. Stereochemistry of Organic Compounds. By D. Nasipuri, New Age International.
10. Rodd's Chemistry of Carbon Compounds Ed. S. Coffey, Elsevier.
11. Natural Products : Chemistry and Biological Significance by J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banithrop and J.B. Horbone, Longmann, Essex.
12. Organic Chemistry of Natural Products. By Gurdeep R. Chatwal, Himalya Publishing House.
13. Organic Chemistry Vol. I & II by I. L. Finar, ELBS.
14. Stereochemistry of Organic Compounds, By PS. Kalsi, New Age International.
15. Organic Chemistry of Natural Products. By Gurdeep R. Chatwal, Himalaya Publishing House.
16. Organic Chemistry Vol. I & II by I.L. Finar, ELBS.
17. Stereochemistry of Organic Compounds, By PS. Kalsi, New Age International.
18. Heterocyclic Chemistry by J.A. Joule K. Mills and GF. Smith Chapman and Hall.
19. Heterocyclic Chemistry; By T. L. Gilkrist, Longman Scientific Technical.

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## **DEC.APP.CHEM. 1.04: PHYSICAL CHEMISTRY**

### **Unit 1: Chemical Dynamics and Surface Chemistry:**

Methods of determining rate laws, collision theory of reactions rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reactions, kinetic salt effects and steady state kinetics. Kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Adsorption-Gibbs adsorption isotherm, estimation of surface area (BET equations) surface films on liquids (Electro-kinetic phenomena), Catalytic activity at surfaces. Surface active agents, classification of surface active agents, micellization, hydrophobic interactions, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counterion binding to micelles, thermodynamics of micellization.

**Unit 2: Nuclear and Radio Chemistry:** Radioactive series - nuclear models, Radioactive decay - artificial radioactivity - Nuclear reactions. - Application of radioactivity, Mossbauer spectroscopy - positron annihilation. Nuclear fission and fusion. Power and breeder reactors. Methods of accelerating nuclear particles for bombardment. Detection and measurement of activity Production and uses of radioactive isotopes and labeled compounds. Tracer chemistry, experimental techniques in the assay of isotopes. Electroscope, counters, chamber and semiconductor radiation detectors, statistics of counting.

**Unit 3: Electrochemistry-1:** Electrolytic solutions, strong electrolytes, ionic atmosphere,

relaxation and electrophoretic effects, quantitative treatment of Debye-Huckel theory and its extension by Onsager. Activity and activity coefficients, mean ionic activity co-efficient, dependence of activity co-efficient on ionic strength (Debye-Huckel limiting law), DH equation for appreciable concentration. Debye-Huckel-Bronsted equations, Electrochemical sensors-Ion selective electrodes, electrochemical biosensors.

**Unit 4: Electrochemistry-II:** Thermodynamics of electrolytic cells, Polarization and over voltage. Decomposition voltage. Electrochemical energy system - Introduction, fundamentals of batteries, classification of batteries, sizes of batteries, battery characteristics, primary batteries, dry cell, alkaline  $MnO_2$  batteries and other batteries. Secondary batteries - lead-acid, alkaline storage batteries-battery charging theory and practice. Energy economics. Fuel cells - type - electrochemistry of fuel cells.

**Unit 5: Chemical Thermodynamics:** Review of basic principle of thermodynamics. [Brief resume of laws of thermodynamics, concepts of free energy and entropy, combined form of first and second laws. Thermodynamic criteria for equilibrium and spontaneity. Variation of free energy and free energy with temperature and pressure]. Maxwell's relations, thermodynamic equations of state. Principle of equipartition energy, heat capacities of solids (Einstein and Debye theories). Physical equilibrium involving phase transitions, Clausius-Clapeyron and its application. Entropy of vaporization and Trouton's rule. Limitations of Van't Hoff's equation. Nemst's heat theorem, determination of free energy change. Third law of thermodynamics, determination of third law entropies, concept of residual entropy.

Thermodynamics of systems of variable compositions, partial molar properties, partial molar volume and its determination, partial molar free energy-chemical potential and its significance, Gibbs-Duhem equation, thermodynamics of ideal and real gases and gas mixtures. Fugacity-its variation and determination, activity, activity co-efficient-different scales of activity co-efficient for solute and solvent, determination of activity co-efficients. Duhem-Margules equation and its application. Thermodynamics of ideal and non-ideal dilute solutions.

### **References:**

1. Fundamental of Physical Chemistry - Maron and Lando, Collier Mac Millian, 1974.
2. Physical Chemistry - Atkins, ELBS, 1982.
3. Physical Chemistry - Barrow, McGraw Hill, Int. St.Ed., 1979.
4. Physical Chemistry - Moore, Orient Longman, 1972.
5. Physical Chemistry - Castellen, Narosa, New Delhi, III Ed.
6. Physical Chemistry - Arthur W. Adamson, Academic Press.
7. Physical Chemistry - Daniels and R.A. Alberty
8. Thermodynamics for Chemists - Glasstone, East West, New Delhi.
9. An Introduction to Chemical Thermodynamics - R.P. Rastogin and S.S. Misra, Vikash, Delhi, 1978
10. Thermodynamics - Rajaram and Kuriakose, East West, Nagin CX, Delhi, 1986
11. Physical Chemistry - Vol. I and II, Gerasimov, MIR, Moscow
12. Chemical Thermodynamics - Klotz and Rosenberg, Benjamin Inc, 1972
13. Theoretical Chemistry - Glasstone, East West, 1973
14. Introduction to Chemical Thermodynamics - R.P. Rastogi and S.S. Misra, Vikash, Delhi, 1978.
15. Thermodynamics - Rajaram and Kuriakose, East West, Nagin CX, Delhi, 1986
16. Chemical Kinetics - Laidler, Harper and Row, DeUii, 1987
17. Kinetics of Chemical Reactions-S.K. Jain, Vishal Publications, 1982
18. Theoretical Chemistry - Glasstone, East West, 1973.
19. Kinetics and Mechanism - Moore and Pearson, Wiley, New York, 1980
20. The Foundation of Chemical Kinetics - Benson, McGraw.

21. Kinetics and Mechanism - Moore and Pearson, Wiley, New York, 1981
22. Techniques in Organic Reaction Kinetics - P.Zumen and R.C. Patel, Wiley, New York, 1984
23. Kinetics of Chemical Reactions - Jain, Vishal, New Delhi
24. Physical Chemistry of Surfaces - Adamson, John Wiley
25. Modern Electrochemistry, Vol. I and II-Bokris and Reddy, Plenum Press, New York, 1970
26. An Introduction to Electrochemistry - Glasstone, East West Ltd.
27. Corrosion Engineering - Fountain and Green McGraw Hill, 1969.
28. Nuclear Chemistry - Friedlander, Kennedy and Miller, Wiley.
29. Essentials of Nuclear Chemistry - Amilkar, Wiley - Eastern.
30. Adsorption and Catalysis - Chakraborty.
31. Electrochemistry - Principles and Applications-Potter.
32. Source Book of Atomic Energy - Glasstone, East West. New Delhi, 1967, 3rd Ed.
33. Chemical and Electrochemical Energy Systems - R.Narayan and B.Viswanathan, University Press, 1998.

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### **DEC.APP.CHEM. 1.05: APPLIED CHEMISTRY PRACTICALS -I**

#### **1. Complexometric Titrations :**

Use of EDTA in the determination of Ca, Mg, Ni, Cu, Zn and Pb.

Determination of hardness of water

Determination of Sulphate (by EDTA back titration after precipitation as BaSO<sub>4</sub>/PbSO<sub>4</sub>)

**2.Redox Titrations:** Determination of Fe by titration using K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and Ce(SO<sub>4</sub>)<sub>2</sub>.

**3.Gravimetric Determinations :** [1] Cu as CuSCN [2] Ni as Ni(dmg)<sub>2</sub> [3] Al as Oxinate

**4.Colorimetric determinations :** [1] Ti using H<sub>2</sub>O<sub>2</sub> [2] Fe using SCN and Phen

**5.Analysis of Ores :** Lime stone, Haematite, Pyrolusite, copper pyrites.

**6.**Analysis of stainless steel for Cr, Ni and Mn.

**7.Flame Photometry :** Determination of Na and K

**8.Ion-exchange :** Separation and determination of Zn and Mg as chlorocomplex anions.

#### **References:**

1. Quantitative Chemical Analysis -1. M. Kolthoff, E.B. Sandell E.J. Meehan and S. Bruckenstein, McMillan Company 1968.
2. Vogel's Text Book of Quantitative Chemical Analysis G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denny, ELBS, Longman 5th edition 1989.
3. Advanced Practical Inorganic Chemistry Gurdeep Raj, Goel Publishing House, 10th edition 1994.
4. A Text Book of Quantitative Chemical Analysis A.I. Vogel, ELBS Longman 3rd edition, 1961.
5. Quantitative Analysis, R.A. Day and A.L. Underwood, Prentice Hall of India, 1993. Commercial method of analysis Snell and Biffen.

### **DEC.APP.CHEM. 1.06: APPLIED CHEMISTRY PRACTICALS –II**

#### **Qualitative Analysis :**

Separation, purification and identification of compounds of binary mixture (two solids or two liquids or one solid and one liquid) using Thin Layer Chromatography, Column Chromatography, Chemical tests, Preparation of solid derivative for the components.



### **Organic Synthesis :**

Organic synthesis involving the following reactions.

Acetylation: Aromatic substitution reaction : Oxidation, bromination, nitration etc.

Aldol condensation. Sandmeyer reaction, Cannizzaro reaction, Friedel Crafts reaction, characterization of the products by M.P. TLC etc.

### **References :**

1. Vogel's Text Book of Practical Organic Chemistry, by Furniss, Hannaford, Smith and Tatchell, ELBS, Longman.
2. Advanced Practical Organic Chemistry by N.K. Vishnoi, Vikas Publishing House.
3. Handbook of Practical Organic Chemistry by Clark.
4. Practical Organic Chemistry by O.P. Agarwal.
5. Comprehensive Practical Organic Chemistry by V. K. Ahluwalia, Renu Aggarwal Universities Press Pvt. Ltd. (2000).

## **DEC.APP.CHEM. 1.07: APPLIED CHEMISTRY PRACTICALS –III**

**Acid catalyzed hydrolysis of methyl acetate:** Determination of reaction order, activation parameter, temperature effect, catalytic effect.

### **Conductometric titrations:**

1. Determination of the strength of strong and weak acids in a given mixture using NaOH.
2. Determination of the activity co-efficient of Zn ions in the solution using Debye-Huckel's limiting law.

Potentiometric titration of silver nitrate V/s potassium chloride

Equilibrium constant determination by potentiometric method.

**pH titration :** HCl V/S NaOH,  $\text{CuSO}_4$ , V/s NaOH, AcOH V/s NaOH

**Partial molar volume :** Methanol-water system, Ethanol-water system.

Determination of pH and pK at various dilutions conductometrically

Study the effect of solvent on the conductance of silver nitrate/ Has and to determine the degree of dissociation and equilibrium constant in different solvents. Determination of thermodynamic quantity of the reaction taking place in chemical cell.

### **References:**

1. Vogel's Text Book of Quantitative Chemical Analysis GH.Jeffery, J. Bassett, J.Mendhan and R.C. Denny, ELBS, Longman 5th edition, 1989.
2. Practical Physical Chemistry. A.M. James and F.E. Prichard, Longman.
3. Findley's Physical Chemistry. B.P. Levitt, Longman.
4. Experimental Physical Chemistry. R.C. Das and Behera, Tata McGraw Hill.
5. Practical Physical Chemistry, J.B. Yadav.  
Experiments in Physics Chemistry J.C. Ghosh, Bharathi Bhavan Publishers.
7. Experimental Physical Chemistry. J.W. Williams and Farrinton Daniels.

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## **FINAL YEAR – M. SC. PREVIOUS (THEORY AND PRACTICAL)**

### **DEC.APP.CHEM. 2.01: ADVANCED INORGANIC CHEMISTRY**

### **Unit 1: Bonding in Metal Complexes:**

**Valence Bond and Crystal Field Theory:** Salient features; Crystal field splitting of d-orbital in octahedral, tetrahedral, tetragonal, and square planar field. Magnitude of  $\Delta$ , factors affecting  $\Delta$ , CFSE evidences for crystal field stabilization: shortcomings of CF.T evidences for covalency.

M.O. treatment of bonding in octahedral complexes involving sigma-bondings; absorption spectra of d1 and d2 systems.

**Magnetic Properties:** high-spin, low-spin complexes, explanation of magnetic properties of complexes based on VBT and CFT

### **Unit 2: Electronic Spectra of Complexes:**

Spectra of transition metal ions-term symbol of dn ions, ground state terms, term splitting in crystal field, inter-electronic repulsion parameters, Orgel diagrams, Tanabe-Sugano diagrams.

Selection rules and band intensities, symmetry, spin-orbit coupling and vibronic coupling effects, charge transfer spectra- LMCT and MLCT.

Interpretation of electronic spectra, calculation of  $\Delta$ , B and P, Spectrochemical series and nephelauxetic series. Spectral properties of divalent 3d metal ion complexes.

### **Unit 3: Magnetic Properties:**

**Magnetic susceptibility :** Types of magnetic behaviours-dia, para, ferro and antiferro magnetism, crystal field and M.O. Interpretation, quenching of orbital moment, spin Orbit coupling, spin-cross over, antiferromagnetic coupling.

Experimental aspects-Gouy and Faraday methods, effects of temperature of magnetic behaviour, magnetic properties and structure. Magnetic behaviour of Co (II) and Cu (II) complexes.

### **Unit 4: Kinetics and Mechanism of Reactions**

Inert and labile complexes; ligand displacement (substitution) reactions in octahedral Co(II) complexes. Base hydrolysis of Cr(III) Complexes, ligand displacement in square-planar Pt (II) complexes, Trans effect. Electron transfer reaction- inner and outer sphere mechanisms; reactions of co-ordinated ligands- substitution, addition and condensation reactions.

### **Unit 5: M-M Bonding:**

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

### **Unit 6: Organometallic Chemistry:**

Introduction Nomenclature, 16 and 18 electron rule, stability, classification of ligands, complexes of  $\pi$ -ligands; Metal carbonyls, metal nitrosyls, synthesis, reactions, Structure and bonding; metal olefin,  $\pi$ -Cyclopentadienyl, and arene complexes.

Basic reactions involving in Organo metallic compounds; addition, elimination, substitution and rearrangement.

### **Unit 7: Industrial Application of Organo-metallic Compounds :**

Homogeneous catalysis; hydrogenation of olefins, Oxo-process, Wacker process, water gas shift reactions, carbonylation. Heterogeneous Catalysis; Fischer-Tropsch reaction, Ziegler-Natta polymerisation.

### **Unit 8: Bioinorganic Chemistry :**

Role of alkali, alkaline earth, Fe, Co, Zn, Mo and Cu metal ions in biological systems;

#### **Transport across the Membrane :**

The transport mechanism, active transport across biological membrane,  $\text{Na}^+\text{K}^+$ -transporting ATPase and  $\text{Ca}^{2+}\text{Mg}^{2+}$ - transporting ATPase, macrocyclic crown ether compounds, cryptands, spherands and ionophores.

### **Metabolism of Inorganic Nitrogen :**

Nitrogen assimilation in animals, nitrate reduction in protista, nitrite reduction in plants, *in vitro* and *in vivo* methods of nitrogen fixation. Nitrogenous, photosynthesis - chlorophyll- PS-I and PS-II

### **Oxygen Carriers:**

Introduction to porphyrin system, substituents effects on porphyrin rings, Haemoglobin (Hb) and myoglobin (Mb)- structure, stereochemistry and oxygenation of Hb and Mb; Non-heme oxygen carriers-hemerythrin and hemocyanin. Synthetic oxygen carriers.

### **Electron Carriers :**

Iron-sulphur proteins (ferridoxins and rubredoxins). Cytochromes: coossification - cytochrome C, cytochrome P-450.

### **Metalloenzymes :**

Mechanism of enzyme action; Catalase and peroxidase, Superoxide dismutase and ascorbic acid oxidase, Alcohol- dihydrogenase, carboxy peptidase-A, xanthin oxidase, aldehyde oxidase, sulfite oxidase and xanthine dedydrogenase. Vit B<sub>12</sub>- coenzyme.

Metal ion deficiency effects, toxicity of metal ions, and treatment of toxicity, chelating agents in medicine, metal complexes as therapeutic agents and anticancer agents.

### **References:**

1. Advanced Inorganic Chemistry, (5th edition)-R.A. Cotton and G Wilkinson; John Wiley and Sons, 1988.
2. Inorganic Chemistry: Principles of Structure and Reactivity (3rd edition)- James E. Huheey, Ellen E. Keither and Richard L. Keither; Harper Collins College Pub., 1993.
3. Inorganic Chemistry (3<sup>rd</sup> Edition)- Shriver and Atkins; Oxford University Press, 1999.
4. An Introduction to Inorganic Chemistry – Purcell and Kotz; Holt-Saunders, 1985.
5. Coordination Chemistry – F. Basalo and R.C. Johnson; W.A. Benjamin Inc., 1979.
6. Coordination Chemistry – S.F.A. Kettle.
7. The Inorganic Chemistry of Biological Processes (2<sup>nd</sup> Edition) – M.N. Hughes.
8. Physical Inorganic Chemistry: A Co-ordination Chemistry Approach – S.F.A. Kettle, Spectrum Pub., 1996.
9. Bioinorganic Chemistry (Reprint 1987)- R.W. Hay; Ellis Horwood/John Wiley & Sons.
10. Bioinorganic Chemistry (1st SAE) – Bertin, Gray, Lippard and Valentine; Viva Books, Pvt. Ltd., New Delhi, 1998.
11. Principles of Bioinorganic Chemistry-S.J. Lippard and J.M. Berg, University Sci. Books.

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## **DEC.APP.CHEM. 2.02: ADVANCED ORGANIC & PHARMACEUTICAL CHEMISTRY**

**Unit 1: Selected Organic Named Reactions:** Aldol, Perkin, Stobbe, Riemer-Tiemann and Reformatsky reactions, Diels-alder reaction. Friedal-Craft's reaction. Wittig reaction, Michael addition, Robinson annulation, Oppenauer Oxidation. Clemmensen, Wolf-Kishner, Birch reduction, Stork enamine reaction, Mannich reaction..Barton, reaction, Shapiro reaction, and Chichibabin reaction.

**Unit 2: Molecular Rearrangements :** Classification and general mechanistic treatment of nucleophilic, electrophilic and free radical rearrangements, Mechanisms of Wagner-Meerwein, Pinaco-pinacolone, benzil-benzilic acid, Fries, Claisen, Beckmann, Hofmann, Curtius, Schmidt rearrangements.

**Unit 3: Use of the following Reagents in Organic Synthesis:**

Gilman reagent, lithium diisopropyl amide (LDA), dicyclohexylcarbodiimide, 1,3-dithiane, trimethylsilyl iodide, tri- n-butyltin hydride, Woodward and Prevost hydroxylation, Osmium tetroxide, DDO, selenium dioxide, phase transfer catalysts - Peterson synthesis, Wilkson's catalyst and Baker's yeast.

**Unit 4: Pericyclic Reactions** : Classification of pericyclic reactions, Electrocyclic reaction: Conrotatory and disrotatory of  $4n$ ,  $4n+2$  any allylic systems. Cycloaddition reactions: Antarafacial and suprafacial addition. Sigmatropic rearrangements.

**Medicinal and Pharmaceutical Chemistry Part I****Unit 5: General aspects of Drug action:**

Introduction, classification nomenclature, theory of drug action and factor affecting drug action. Metabolism of drugs structural features and pharmacological activity.

Chemistry and pharmacological activity,

Uses and adverse effects of the following classes of drugs,

(a) Adrenergic drugs, i. Adrenaline ii. Salbutamol

(b) Cardiovascular drugs i. Antihypertensive

i. Clonidine                      2. Reserpine

(c) Analgesic antipyretics (non-narcotic (NSAIDs)

i. Aspirin ii. Ibuprofen iii. Indomethacin iv. Diclofenac Opioid analgesics (narcotic analgesics) i. Morphine ii. Pethidine iii. Methadone

(d) Sedatives and hypnotics i. Barbiturates (Phenobarbitone)

ii. Benzodiazepines (diazepam)

(e) Psychopharmacological drugs

i. Antidepressants (Imipramine, amitriptyline)

ii. Antipsychotics (Chlorpromazine)

f) Anticoagulants i. Oral anticoagulants

1. Warfarin 2. Dicumarol

(g) Antihistamines Physiological and pathophysiological role of histamine i. Diphenhydramine ii. Promethazine iii. Cetirizine (non sedative)

(h) Chemotherapeutic agents:

a. Antibacterials b. Antifungal c. Antiviral d. Anticancer

**Unit 6: Importance of Quality Control:** Drug and pharmaceuticals sources of impurities in pharmaceutical chemicals, analytical quality control in finished / final products. Common methods of assay, analysis of a few common drugs analgesics, (anthelmintics), vitamin A, Vitamin C, Aspirin, Paracetamol, (Ephedrine), (Atropine) and glucose.

**Unit 7: Synthesis of Typical Drugs:** Sulpha drugs, (Sulphanilamide, sulphapyridine, sulphathiazole antimalarials (Chloroquine, primaquine), Analgesics (pethidine), Paracetamol Indomethacin, Sedative and hypnotics (Quinobarbitone, Diazepam), Antihistamine (Diphenhydramine) Antibiotics: Penicillium G

**References:**

1. Advanced Organic Chemistry by Jerry March John Wiley & Sons.
2. Organic Chemistry by Seyhan Ege, D.C. Heath & Company.
3. Organic Chemistry by I.L. Finar Vol. I & II ELBS & Longmans.

4. A Guide Book to Mechanism in Organic Chemistry by Peter Sykes Orient Longman.
5. Organic Chemistry By P.Y. Bruice, Prentice Hall International.
6. Heterocyclic Chemistry R.K.Bansal, New Age International (P) Ltd
7. Organic Chemistry By Morrison and Boyd, Prentice Hall International.
8. Advance Organic Chemistry Part A & B By F.A. Carey and Sundberg Plenum Press.
9. A Textbook of Medicinal Chemistry, Vol.I and Vol II, S.N.Pandeya, S.A.Publishers, Varanasi.
10. Pharmaceutical Chemistry by G.R.Chatwal et al, Himalaya Publishing House, New Delhi, 1991.
11. Pharmaceutical analysis – edited by T.Higuchi and E>B. Hanssen, John Wiley and Sons, INC, New York
12. The Quantitative analysis of drugs – DC.Garratt Chappman and Hall, ltd, II New Fetter lane, London.
13. Drugs and Pharmaceutical Sciences series, Macrel Dekker Vol.II, INC, New York.
14. Quantitative Analysis of Drugs – P.D. Sethi
15. Pharmaceutical Chemistry – Leslic G Chattan.
16. A Textbook of Medicinal Chemistry, P.Parimoo. CBS Publications and Distributors, 1995.
17. Medicinal Chemistry, Ashutosh Kar (New Age International Publishers).
18. Organic Drugs Synthesis, Ledniser Mitzshen Vol.I and Vol II.
19. Synthesis of Drugs, Rothe and Knellmann.

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## **DEC.APP.CHEM. 2.03: Polymer Chemistry and Technology**

### **Unit 1: Importance of Polymers, Basic Concepts :**

Monomers, repeat units, degree of polymerization, Linear, branched and network polymers. Classification of polymers. Polymerization: Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems, Polymerization Techniques.

### **Unit 2: Polydispersion-Average Molecular Weight Concept.**

Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers- chemical analysis of polymers, spectroscopic methods, X-ray diffractonstydy. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

### **Unit 3: Morphology and order in crystalline polymers-**

configuradons of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point  $T_m$ -melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature,  $T_g$ -Relationship between  $T_m$  and  $T_g$ , effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

### **Unit 4: Testing of Polymers :**

Need for testing-specifications and standards, mechanical-short term (tensile, fluxural, impact, tear resistance, abrasion resistance etc.) long term (creep and fatigue). Electrical-conductivity, volume resistivity, surface, breakdown voltage, dielectric constant, loss factor, thermal co-efficient of thermal expansion, heat distortion temperature, vicat softening point, low temperature, properties, thermal conductivity.

**Unit 5: Solution Properties of Polymers :**

Polymer dissolution, criteria, thermodynamics, Flory-Huggins Theory, nature of polymer molecules in solution, their size and shape, theta solvent, theta temperature, thermodynamics of mixing, solution viscosities.

**Unit 6: Polymer Processing:**

Plastics, Elastomers and fibres, compounding. Processing techniques; calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding thermoforming, foaming reinforcing and fibre spinning.

**Unit 7: Properties of commercial polymers :**

Polyethylene, polyvinyl chloride, polyamides, polyester, phenolic resins, epoxy resins and silicon polymers. Functional polymers fire retarding polymers and electrically conduction polymers, Biomedical polymers; contact lens, dental polymers, artificial heart, kidney skin and blood cells.

**References:**

1. Text book of Polymer Science (3rd edition) F. W. Billmeyer, A Wiley-Interscience, 1984.
2. Contemporary Polymer Chemistry (2nd edition),  
H. R. Alcock and F. W. Lampe, Prentice Hall, Englewood Cliffs, New Jersey, 1981.
3. Polymer Science, V.R. Gowarikar, N.V. Viswanathan and Jayadev Sreedhar, New Age International (P) Limited, August 1996.
4. Introductory Polymer Chemistry, G.S. Misra, Wiley Eastern Limited, 1993.
5. Polymer Science and Technology of Plastics and Rubbers, Premamoy Ghosh, Tata McGraw Hill, 1990.
6. Polymer Characterisation, Physical Techniques, D. Campbell and J.R. White, Chapman and Hall, 1989.
7. Principles of Polymer Science Systems, F. Rodriguez, McGraw Hill Book Co., 1970.

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**DEC.APP.CHEM. 2.04: SELECTED TOPICS IN INDUSTRIAL CHEMISTRY****Unit 1: Unit Operations:**

Introduction to the principles of unit operation. Units and dimensions, Conversion to SI units, Dimensional analysis for unit constants, Stoichiometric and composition relationships, chemical equations, Material Balance (without and with Chemical reactions) and energy balance. Steam properties, steam table, calculations involving the utilization of steam, boilers-classification and efficiency.

Principles of heat transfer, Mechanisms of heat transfer- steady state and unsteady state heat conduction, heat flow by convection and radiation, heat exchangers and evaporators. Boiling heat transfer. Principles of mass transfer, mass transfer coefficient in laminar and turbulent flow, interphase mass transfer, molecular diffusion in gases, liquids and solids. Principles and industrial equipment involved in the following unit operations-crystallization, evaporation, filtration, distillation, extraction and drying.

An introduction to quality control and quality assurance-Basic concepts, quality assurance, aspects of specification and tolerance, quality acceptance, sampling, reliability, cost aspects of quality decisions. Quality control in raw materials, production (in process), finished products.

Current trends in quality control, ISO 9000 and ISO 14000 series. Laws related to quality control. Case studies of quality control in various industries such as plastics and polymers, fertilizers, agrochemicals, petrochemicals. Dyes and pharmaceuticals.

**Unit 2: Case Studies of the Following Organic Process :** Nitration, Halogenation, Oxidation, Reduction, Sulphonation, Alkylation, Amination (Reduction and Aminolysis), Esterification, Hydrogenation, Hydrolysis.

**Outline of Chemical Technology:**

**Unit 3: Inorganic Chemical Industries :** Sulphur, nitrogen. Phosphorous, Electrochemical, Chloro-Alkali Industries, Cement-Line, Air-Water.

**Unit 4: Natural Product Industries :** Oil, Soaps-Detergents, Paints Varnishes, Fermentation, Food, Pulp and Paper, Coal, petroleum.

**Unit 5: Synthetic Organics:** Aromatics, Pesticides, Pharmaceutical

**Unit 6: Metallurgical Industries :** Iron-Steel, Aluminium, Copper, Zinc, Lead.

**References:**

1. Transport processes and Separation process principles. C.J. Geankoplis, IV edition, Prentice Hall of India, 2005.
2. Stiochiometry for Chemical Engineering. William and Johnson.
3. Stiochipmetry 2nd edition. Bhatta and Vora, Tata McGraw Hill, 1970.
4. Chemical Engineering, 2nd edition. ELBS, Coulsion and Richardson.
5. Uni Operation in Chemicl Engineering, 2 nd edition, McCabe and Smith, McGraw Hill, 1967.
6. Unit Operation II ( Heat and Mass Transfer), 9<sup>th</sup> edition, Gavhane, Nirali Prakashan, 1999.
7. Unit Operations of Chemicl Engineering Vol.I &II, Chattopadhaya, Khann, Delhi, 1998.
8. Statistical Quality Control, 2 nd edition, Manohar Maharajan, Dampat Rai and Sons, 1995.
9. Unit Processes on Organic Synthesis, P.H.Groggins, McGraw-Hill Book House, New York.

#### **DEC.APP.CHEM. 2.05: APPLIED CHEMISTRY PRACTICALS –IV**

1. Preparation of Co-ordination compounds  
 $\text{Hg}\{\text{Co}(\text{sCN})_4\}$ ,  $\text{Ni}(\text{dMG})_2$ ,  $\text{Mn}(\text{acac})_3$ ,  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ ,  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ ,  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
2. 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  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
3. Determination of Ionisable Cl from complexes
4. Determination composition of complexes
5. Determination of stability constants
6. Determination of magnetic susceptibility of paramagnetic materials by using Guoy magnetic balance.
7. Recording electronic spectra of complexes: interpretation and assignment of bands.
8. Recording IR spectra of ligands and complexes and interpretation.
9. Seperation of Ni, Mn, Co and Zn by TLC
10. Determination of Uranium by extractive spectrophotometry.
11. Paper Chromatography-Separation of Fe and Ni; Cu and Ni
12. Potentiometric titration; Cu vs EDTA
13. Determination of iron in mustard seeds by calorimetric method.
14. Determation of Phosphate in peas by calorimetric method.

**References:**

1. Quantitative Chemical Analysis-I.M. Kolthoff, E.B. Sandell E.J. Meehan and S. Brukenstein, McMillan Company, 1968.
2. Vogel's Text Book of Quantitative Chemical Analysis G.H. Jeffery, J. Bassett, J. Mendhan and R.C. Denny, ELBS, Longman 5th edition, 1989.
3. Advanced Practical Inorganic Chemistry- Gurdeep Raj, Goel Publishing House, 10th edition, 1994.
4. A Text Book of Quantitative Chemical Analysis -A.I. Vogel, ELBS Longman 3rd edition, 1961.
5. Quantitative Analysis R.A. Day and A.L. Underwood, Prentice Hall of India, 1993.
6. Commercial Method of Analysis Snell and Biffen.

**DEC.APP.CHEM. 2.06: APPLIED CHEMISTRY PRACTICALS –V**  
(Preparation and Determinations of Dyes, Drugs and Agrochemicals)

**Determinations:**

1. Determination of Phenols
2. Determination of amines and amino acids
3. Determination of carbohydrates
4. Determination of aldehydes and ketones
5. Determination of hydroxy group
6. Determination of ascorbic acid in tablet
7. Determination of mepacrine in tablet
8. Determination of Cholestrol
9. Determination of Saponification value
10. Determination of acetyl and iodine values.

**Preparations:**

Preparation of some important drugs, dyes (dying of cotton, polyester and wool) and agrochemicals involving multistep organic synthetic reactions such as acetylation, acylation, alkylation, condensation, hydrolysis, esterification, diazotisation and molecular rearrangements.

**References:**

1. Vogel's Text Book of Practical Organic Chemistry, by furniss, Hannaford, Smith and Tatchell, ELBS, Longman
2. Advanced Practical Organic Chemistry by N.K. Vishnoi, Vikasa Publishing House.
3. Handbook of Practical Organic Chemistry by Clark.
4. Practical Organic Chemistry by O.P.Agrawal.
5. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia, Reny Agarwal Universites Press Pvt. Ltd. (2000).

**DEC.APP.CHEM. 2.07: APPLIED CHEMISTRY PRACTICALS –VI**

1.  $p^{ka}$  values of weak acids by potentiometric method
2. Determination of  $cuSO_4$  spectrophotometrically
3.  $p^H$  and  $p^{ka}$  values of weak acids by conductometric method
4. Estimation of iodine in iodized common salt using iodometry
5. Partition coefficient of acetic acid in water and butanol
6. Electrogravimetry
7. Kinetics of the reaction between potassium iodide and potassium perrsulphate
8. Phase-diagram
9. An experiment to determine the energy of activation
10. Chemical oxygen demand (COD)
11. Effect of ionic strength on rate constant of the reaction.