

Programme Project Report (PPR)
for
Distance Learning Programme under School of Distance Education

Post Graduate Certificate in Instrumental Methods of Chemical Analysis
(PGCIMA)

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Academic support by

School of Chemical Sciences

Mahatma Gandhi University

Kottayam, Kerala

POST GRADUATE CERTIFICATE IN INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(Distance Learning Programme - Certificate Programme)

Programme Project Report

Mahatma Gandhi University started the School of Distance Education in 1989 with a vision to provide the opportunity of quality education to all realms of society. Since the beginning, thousands of students availed this opportunity for higher education throughout Kerala to a great extent and also outside the state to some extent. But after the new directions of UGC in 2014, University had stopped all its Off-Campus Centres of the School of Distance Education inside and outside the State.

Now it is the new endeavour to revamp the functioning of the school with different types of Diploma and Certificate programmes very relevant to the contemporary society, in addition to the conventional Graduate and Post Graduate programmes with the academic and infrastructural support of the eminent Schools and interdisciplinary interuniversity Centres of the University. All these Schools/ Centres have already conducted similar Programmes or Post Graduate Programmes in the same area. This Certificate Programme has been designed by the School of Chemical Sciences and to be conducted by the School of Distance Education with the academic support of the School.

The School of Chemical Sciences is one among the initial statutory departments of Mahatma Gandhi University. The academic programmes of the School of Chemical Sciences (SCS) were initiated from the very inception of the university. At present the school offers four different M.Sc. programmes along with M.Phil, M. Tech and Ph.D programmes covering all branches of chemistry and polymer science. The school, since its inception, has been making a steady progress in all spheres of activity and has academic programmes spread in four broad divisions namely Inorganic Chemistry, Organic Chemistry, Physical Chemistry and Polymer Chemistry. In spite of the nationwide diversions of talented students from basic sciences, more than 1000 students appear for our entrance tests to graduate programmes annually. Keeping in view the vision and mission of the School, the syllabi of the various courses are frequently updated introducing new

courses in emerging areas with inter-disciplinary content. The faculty members are actively engaged in research in various branches like synthetic organic chemistry, theoretical and computational chemistry, catalysis, material and solid state chemistry, nanochemistry and technology, photochemistry, polymer composites etc. The school has state-of-the-art instrumentation facility for research activities.

a) **Programme's mission & objectives :**

The aim of the certificate course **Instrumental Methods for Chemical Analysis** through distance learning programme is to prepare students to become experts and develop skills towards doctoral studies, and /or professional industrial careers in chemical analysis, structure characterization of materials. This module will provide the student with an understanding of the theory, practices and instrumentation associated with various analytical techniques.

b) **Relevance of the program with HEI's Mission and Goals :**

The course focuses on state-of-the-art developments in their practices and instrumentation, as well as issues to deal with the identification of samples in complex matrices. This course places a strong emphasis on the professional development of the students. Such a qualification will enable and facilitate career progression for the students.

c) **Nature of prospective target group of learners:**

Science graduates can join the programme. Students doing their Masters/M.Phil/Doctoral studies can also join the programme to strengthen their analytical skills.

d) **Appropriateness of programme to be conducted in Open and Distance Learning mode to acquire specific skills and competence :**

This course places a strong emphasis on the professional development of the students. Such a qualification will enable and facilitate career progression for the students. On successful completion of this module, a student will be able to (i) Understand the principles, practices and instrumentation associated with various analytical techniques, (ii) Describe sample preparation and method development issues relating to the use of advanced techniques for analysis and identification, (iii) Competently operate and calibrate associated laboratory instrumentation, and (iv) Critically appraise the literature and identify future trends in this area.

e) **Instructional Design :**

The course is of 6 months which includes theory and practicals. Study materials will be given by online. Test papers and assignments are also online. 20% of the practicals is by virtual lab.

Course Code	Course Type	Contact Classes (Hrs)	Course Name	Credits	IA Marks	ESE Marks	Total Marks
SDE-SCS-1	Common Core course (Theory)	12	Spectroscopic Methods of Analysis	4	20	80	100
SDE-SCS-2	Common Core course (Theory)	12	Chromatographic Techniques	4	20	80	100
SDE-SCS-3	Common Core course (Theory)	12	Electroanalytical Techniques	4	20	80	100
SDE-SCS-4	Common Core course (Practical)	60	Applications of Analytical Techniques	2	20	30	100
			Project	2		50	
Total		96		16	80	320	400

f) **Procedure for admissions, curriculum transaction and evaluation:**

Any student with minimum B.Sc. degree in science can apply. The student has to pay an amount for the programme which is decided by the University. The course contents will be delivered online. For practicals, 20% will be virtual and remaining will be by direct laboratory work. This course will have three types of graded activities that will be included in overall course grade. These include: **Assignments:** Answer monthly quizzes that account for 20% of the course total grade. Each quiz includes 20 multiple choice questions that examines your understanding of the learning materials. **Open-ended Questions:** Answer two open-ended questions that account for 80% of the course total grade. The questions encourage creative thinking, and their answers are based on the knowledge gained in the course. **Final project:** At the end of the course the candidate will be asked to complete a final project. It will consist of a written report that focuses on the utilization of analytical techniques for various applications. The final project will be graded and will contribute to 25% of the overall course grade.

Admission to the programme will be done by the University through a common procedure for all the programmes under the School of Distance Education. Fee structure will be decided by the University. The School will prepare an academic calendar/activity planner and will be circulated among all the learners at the time of admission itself. The academic calendar will include all the significant activities, important dates, schedule of submission of assignments, schedule of contact classes, schedule of examinations, etc.

Evaluation of the courses shall be done by the faculty themselves on the basis of internal assessment and end semester examinations. 20% of the marks will be decided by the internal evaluations and the remaining 80% by the end semester examinations which will be done by the University. The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

Grading System will be followed for the evaluation on a ten point scale. The details of the grading system are given in the following Table.

Percentage Equivalence of Grade:

Range of % of Marks	Grade Letter	Performance	Grade Point
95 - ≤ 100	O	Outstanding	10
85 - < 95	A plus	Excellent	9
75 - < 85	A only	Very Good	8
65 - < 75	B plus	Good	7
55 - < 65	B only	Above Average	6
45 - < 55	C	Average	5
40 - < 45	P	Pass	4
< 40	F	Fail	0
Absent	Ab	Absent	0

'P' grade is required for a minimum pass in a course. The minimum GPA required for a pass in the Certificate programme is 4.

Calculation of Grade Point Average (GPA) :

Credit Points for the Course = (No. of Credits assigned for the course x Grade Point secured for that course).

GPA indicates the performance of a student in the programme. GPA is based on the total **credit points** earned by a student in all the courses divided by the total number of credits assigned to the courses required in the programme.

Note: GPA is computed only if the candidate passes in all the required courses (gets a minimum required grade for a pass in all the required courses as per the curriculum).

GPA =

$$\frac{\text{Total credit points earned by the student from all the required courses of the programme}}{\text{Total credits of all courses required in the programme}}$$

This formula shall be printed on the Grade Card issued to the student with a note that it could be used to convert the grades into mark-percentages. (The details of the grading system as indicated above shall also be printed on the Grade Card).

Conversion of GPA to Grade

GPA	Grade
10	O
9.0 - < 10	A plus
8.0 - < 9	A only
7.0 - < 8	B plus
6.0 - < 7	B only
5.0 - < 6	C
4.0 - < 5	P
< 4	F
Absent	Ab

Conversion of GPA to percentage

$$\text{Equivalent Percentage} = (\text{GPA obtained}) \times 10$$

g) **Requirement of the laboratory support and Library Resources:**

To handle the practical components in syllabus, technicians and consumables are required. The Laboratory facility of the school shall be provided to the students during holidays and vacation. Certain level of the practical would be conducted and performed by applying virtual reality methods

Mahatma Gandhi University Library and Information System consists of University Library, libraries of the Schools and 4 study centre Libraries. The University Library was established in 1989. The University Library which is situated in the main campus occupies purpose-built accommodation, and provides a variety of facilities and has a user-friendly environment. These include individual work spaces, room for group study and teaching, audio-visual access and online information retrieval system. The building of the University Library is 2000 sq.m in area consisting of the cellar, the ground floor and the first floor.

Academic as well as public users are given the facility to use the library. Special category membership is provided to journalists. The library is providing service from 8 am to 8 pm in three shift timings for its staff. The library functions on an average of 345 days in a year. The libraries of teaching departments are open during working hours of the Schools. Reading space is provided in all the three floors housing the various sections of the library. The library provides reading facility to the visually impaired users too. For this, an electronic lab custom made for visually and physically challenged users has been set up during 2016.

The University Library has a Library Advisory Committee. It is an 18 member committee with Vice-Chancellor as Chairman and University Librarian as Convener.

The library has a collection of 59,000 books, 232 journals, 2,135 Ph.D. theses and has access to 15000+ e-journals under E-Shodh Sindhu. The activities of the Library are

comprehensively automated using open source library management software KOHA. OPAC, Journal Article Index, By monthly Bibliography compilation and Literature Search Service are also available

The library is a member of the INFLIBNET Centre, Ahmedabad as well as DELNET (Developing Library Network). As a member of these networks, the library provides access to the resources of other major libraries in the country. In addition to the access to UGC INFONET consortium, it has access to major online databases, such as EBSCO, ProQuest dissertations and theses, Oxford Scholarship Online, IEEE All Society Periodicals Package etc. Mahatma Gandhi University had won the State IT Award during the year 2009 in the e-learning category for its university online theses digital library. The various department libraries have a good collection of subject specific books and journals.

A. MAHATMA GANDHI UNIVERSITY LIBRARY	
Category	No.
Books	59000
Journals	232
Bound Journals	7500
Ph.D Theses	2135
E-Journals (in UGC-Infonet, renamed as E-ShodhSindhu)	15000
Online databases (in UGC Infonet)	11
Online Archives subscribed	185 Titles
Online databases subscribed	4
E-books	7338
DVDs: Educational Videos	293

B	Name of School/Centre	Total No. of books
	School of Chemical Sciences	4100

h) **Cost estimate of the programme and the provisions:**

The budget detail for the programme is given in the following Table.

Budget Estimate

S. No.	Item	Amount (Lakh)
1	Online study materials	1.5
2	Online virtual lab.	1.5
3	Online quizzes/assignments/evaluation	1
4	Laboratory demonstrations	2
5	Contact classes	1

	TOTAL	7 Lakh
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Total Programme fee: Rs.7000/-

i) Quality assurance mechanism and expected programme outcomes:

The quality of the programme will be ensured through strict monitoring by an executive committee including the Co-ordinator of the programme, the subject experts, Director, School of Distance Education and Head of the School of Chemical Sciences. The Co-ordinator of the programme shall ensure the regular student feedback of courses, teachers and programme in the prescribed format towards the end of the semester and the same shall be analysed to draw conclusions for effecting improvement. Periodical review meetings on the programme efficacy will be held in which the remarks of teachers on curriculum, syllabi and methods of teaching and evaluation will be given due importance. Moreover, the progress and the quality of the programme will be monitored by the Internal Quality Assurance Cell of the University from the outcome and feedback of the learners as well as the proper documentation maintained in the Centre.

Syllabus

Post Graduate Certificate in Instrumental Methods of Chemical Analysis

Month 1: UV-Vis. Spectroscopy: Electronic spectroscopy, basic principle, electronic transitions in organic, inorganic and organometallic molecules and application to structure elucidation. Basics of ultraviolet light absorption, terminology, laws of light absorption, measurement of the spectrum, presentation of the spectrum, solvents for uv/vis spectroscopy, UV/vis. spectroscopy generalizations. Types of electronic transitions. Typical absorptions of simple isolated chromophores. Empirical rules for calculating UV/vis. absorptions: Woodward-Fieser rules. Instrumentation, Applications based on the above topics.

Month 1: IR Spectroscopy: Introduction, electromagnetic radiation, molecular vibrations, infrared spectroscopy basics, instrumentation. General approach to IR spectrum analysis, Table of functional group absorptions, example spectra for various functional groups. Problems on spectral interpretation with examples.

Month 1 : Raman Spectroscopy: Introduction, Instrumentation, Raman spectroscopy of molecules, predicting number of active modes of vibrations, analysis of representative spectra of various compounds with various functional groups at the coordination sites; application of isotopic substitution.

Months 2-3: NMR Spectroscopy: NMR Basics and ^1H Resonance: nuclear spin states, chemical shift, instrumentation, solvents for ^1H NMR. informations from NMR spectroscopy: chemical equivalence, integration, factors influencing chemical shifts, ^1H correlation chart, spin-spin splitting (n+1 rule), coupling constants. ^{13}C Resonance: Background, ^{13}C Correlation chart, ^{13}C Correlation chart for carbonyl compounds, solvents for ^{13}C NMR. ^{13}C NMR spectroscopy, proton-coupled ^{13}C spectra, proton-decoupled ^{13}C spectra, off-resonance proton-decoupled ^{13}C spectra. special considerations in ^{13}C nmr spectroscopy, nuclear overhauser enhancement, problems with integration of ^{13}C spectra, heteronuclear coupling in ^{13}C spectra, Calculating Chemical Shift Values. In ^{13}C NMR spectroscopy, base values for ^{13}C chemical shift in typical hydrocarbons. Problems based on various techniques.

Month 4: Mass Spectroscopy : Introduction, instrumentation, basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution MS, soft ionization methods, ESI-MS and MALDI-MS, Problems on spectral interpretation with examples.

Month 5: Chromatographic Techniques: Principle, instrumentation and applications of gas chromatography, high performance liquid chromatography(HPLC), ion exchange chromatography, size exclusion chromatography, thin layer chromatography(TLC). Interpretation of results.

Month 6: Electro analytical Techniques

Introduction, basic principle, and instrumentation, applications of electro analytical techniques such as impedance analysis, cyclic voltammetry and amperometry. Interpretation of results.