UNIVERSITY OF THE PUNJAB

NOTIFICATION

It is hereby notified that the Syndicate at its meeting held on 17-12-2022 has approved the recommendations of the Academic Council made at its meeting dated 03-06-2022 regarding approval of the Syllabi & Courses of Reading for one year Postgraduate Diploma (PGD) in **"Chemistry and Entrepreneurship"** under Semester System at the Centre for Research in Ionic Liquids (School of Chemistry) w.e.f. the Academic Session, 2022-2023 and onward.

The Syllabi & Courses of Reading for one year Postgraduate Diploma **"Chemistry and Entrepreneurship"** is attached herewith as Annexure-A.

Sd/-
SHAHID JAVED
Registrar

Admin. Block,
Quaid-i-Azam Campus,
Lahore.

No. D/ 424 /Acad. **Dated: 12- 01/2023.**

Copy of the above is forwarded to the following for information and further necessary action: -

1. Head, School of Chemistry
2. Director, Centre for Research in Ionic Liquids
3. Director, IT for placement at website.
4. Controller of Examinations
5. Admin. Officer (Statutes)
6. Secretary to the Vice-Chancellor
7. PS to Registrar
8. Assistant Syllabus.

Assistant Registrar (Academic)
for Registrar

Post-Graduate Diploma (PGD)

Chemistry and Entrepreneurship

PGD (Chemistry and Entrepreneurship) 1-year program will be held on semester system comprising of two semesters in one year. The scheme of study, syllabi and courses for PGD 1st and 2nd semesters are given below:

Total Credit Hours: 24

Semester # 1			
Course Codes	**Course Titles**	**Credit Hours**	**Total Credit Hours**
PGD-501	Analytical Chemistry Techniques	03 Credits	12
PGD-502	Contemporary Organic Chemistry	03 Credits	
PGD-503	Advanced Practical Chemistry	03 Credits	
PGD-504	From Bench to Bank	03 Credits	
Semester # 2			
PGD-505	Green and Sustainable Chemistry	03 Credits	12
PGD-506	Process Development and Optimization	03 Credits	
PGD-507	Business Management	03 Credits	
PGD-508	Internship/Project	03 Credits	
Total Credit Hours for PGD (Chemistry and Entrepreneurship) (1-Year Program)			24

Learning Goals

1. Basics of business plans, business concepts, project management and creative problem solving
2. Transformation of novel chemistry research into successful business projects
3. Inter-relationship between fundamental chemistry research and its commercialization (development of new processes and products on industrial level)
4. Academia-industry linkages
5. Effective communication of scientific knowledge
6. Enabling the graduates to make informed and ethical scientific discussions
7. Appropriate quantitative skills learning for making decisions

SEMESTER I

Analytical Chemistry Techniques (PGD-501)

Course description

Analytical Chemistry covers introduction to Analytical chemistry and basic concepts essential for lab-scale research and for initializing an industrial set-up. An emphasis is placed on basic knowledge of characterization techniques such as High Performance Liquid Chromatography (HPLC), Gas Chromatography-Mass Spectrometry (GC-MS) and Nuclear Magnetic Resonance spectroscopy (NMR).

Course objectives

The objectives of this course are to;

1. Develop understanding of Analytical Chemistry techniques and its connection with industrial chemistry.
2. Inculcate skills of separation/purification of synthesized/extracted product.
3. Enable students to carry out characterization of synthesized/extracted product.

Course content

Module 1: Assessment of Analytical data

Introduction and scope of Analytical Chemistry, Analytical problems and their solutions, Analytical methods, concentration units and conversion of concentration, errors, precision and accuracy, limits of detection, confidence limits; Standard deviation, rounding off analytical data, Significance of sampling, weighing and measuring in Analytical chemistry, calibration of instruments

Module 2: Basic Analytical techniques and industrial analytical tests

Crystallization, solvent extraction, paper chromatography, thin layer chromatography, column adsorption chromatography, basic industrial analytical test e.g. iodine number, purification of oil/ghee, rancidity, saponification number and introduction of some advanced but simple instruments such as viscometer, densitometer, auto-titrator, practical applications

Module 3: Basic characterization techniques

General introduction and use of basic techniques; UV-Vis, Infrared spectroscopy, flame photometry, atomic absorption spectroscopy

Module 4: Advanced Analytical techniques-I

High Performance Liquid chromatography (HPLC) and Gas chromatography-Mass spectrometry; instrumentation, interpretation of data, qualitative and quantitative analysis through these techniques

Module 5: Advanced analytical techniques-II

X-Ray crystallography, Nuclear Magnetic Resonance spectroscopy; chemical shift scale, TMS as reference samples, Proton NMR, Carbon-13 NMR, quantitative analysis and integration, elucidation of NMR spectra

Teaching strategies

Lectures, slides, lab demonstration, effective class discussions, team-based learning, quizzes, assignments, presentations by students

Assessment and examination

Sr. No	*Elements*	*Weightage*	*Details*
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Recommended Books

1. Fundamental of Analytical Chemistry by Doughlas Skoog and Donals M. W. West, Holt Reinchart and Inc, London.
2. Organic Chemistry by Jonathan Clayden, Nick Geeves, Stuart Warren, Oxford University Press 2000
3. Chromatography by R.K Sharma, Gogel publishing home meerret.
4. Paper chromatography by Dr.Friedrich Cramer, London Macmillan and Co Ltd.
5. Thin- layer chromatography by Marini, Elservier publisher.
6. Modern Analytical Chemistry by David Harvey, Roohani-art press, Islamabad.
7. Chromatographic methods of analysis by Stock & Rice, Elsevier Co. Amsterdam.
8. Mass Spectrometry textbook by Jurgen H Gross, Springer-Verlag Berlin Heidelberg.
9. Introduction to spectroscopy by Donald, L. Pavia, Thomson Learning, Inc. Washington.

Contemporary Organic Chemistry (PGD-502)

Course description

Contemporary Organic Chemistry covers topics in organic chemistry. An emphasis is placed on basic knowledge of organic chemistry, applying it in lab and ultimately in industries. This course is important for students who wish to have an advanced understanding of the methods to prepare organic molecules and start the industrial carriers. It will provide students extensive laboratory experience in synthetic chemistry.

Course objectives

The objectives of this course are to;

1. Develop disciplinary knowledge with critical thinking and solution seeking practices.
2. Provide know-how of organic molecules and fundamentals of organic chemistry.
3. Enable students to carrying out synthesis in lab with selectivity of product.

Course content

Module 1: Organic chemistry and industry

Organic chemistry and you, organic compounds, organic chemistry and industry; petrochemicals industry, plastics and polymers industries, perfumery industries, synthetic flavorings, food, drugs, agrochemicals, organic chemistry and periodic table

Module 2: Organic molecules

Introduction to organic molecules, drawing structures of organic molecules, fundamentals of functional groups

Module 3: Organic reactions

Conditions required for a reaction, not all collisions between molecules result in chemical change, nucleophiles and electrophiles, drawing reaction mechanisms

Module 4: Selectivity in a chemical reaction

Introduction to selectivity, chemoselectivity, regioselectivity and stereoselectivity

Module 5: How to plan organic reactions in lab?

Planning a synthesis, literature review, carrying out a reaction, catalysis, phase-transfer catalysts, solvents use, choice of solvent, green solvents, reducing the environmental hazards, eco-friendly approach, characterization and purification of product

Module 6: Current aspects of organic chemistry

Science advances through interaction between disciplines, chemistry vs viruses, commercial synthesis of some biologically important drugs, future of organic chemistry

Teaching strategies

Lectures, slides, lab demonstration, effective class discussions, team-based learning, quizzes, assignments, presentations by students

Assessment and examination

Sr. No	***Elements***	***Weightage***	***Details***
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Recommended Books

1. Organic Chemistry by Jonathan Clayden, Nick Geeves, Stuart Warren, Oxford University Press 2000
2. Organic Synthesis: Strategy and Control by Paul Wyatt and Staurt Warren, Wiley 2007
3. Principles in Organic Synthesis by R.O.C Norman & J. M. Coxon, Chapman and Hall, 1993.
4. March's Advanced Organic Chemistry by Jerry March, Wiley, 2007

Advanced Practical Chemistry (PGD-503)

Course description

The course is compulsory for training the graduates about applying scientific knowledge in laboratory.

Course objectives

The objectives of this course are to;

1. Enable students to design and perform a lab project
2. Provide students disciplinary knowledge and practice of working in laboratory with independence and integrity
3. Develop critical thinking about how chemistry happens in flask with social and environmental responsibilities

Course contents

Module 1: Hazardous chemicals and chemical safety

Safety training, hazardous substance, acute vs. chronic, routes of exposure, toxicity, labeling of chemicals, HCS pictograms and hazards, Fire protection, Secondary containers, Safety Data Sheets (SDS), COSSH, minimizing hazard, Standard Operating Procedures (SOPs), Personal Protective Equipment (PPE), Preparing for emergencies, Safety equipment, storage of special chemicals, fuming hoods, Lab construction material and design of benches and cupboards,

Module 2: Project based on:

- Calibration of instruments
- Chromatographic separation of compounds
- Estimation of metals/organic compounds in given sample
- Basic industrial analytical test experiments e.g. iodine number, purification of oil/ghee, rancidity, saponification number etc
- Extraction of product from natural source
- Characterization of unknown product
- Multi-step synthesis
- Synthesis of green solvents; ionic liquids/deep eutectic solvents
- Estimation of the purity of some organic aromatic compounds by HPLC technique
- Analysis of commercial pharmaceutical produc

Teaching strategies

Lab projects, Lab reports, effective class discussions, team-based learning

Assessment and examination

Sr. No	*Elements*	*Weightage*	*Details*
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Books Recommended

1. Practical Organic Chemistry by F. G. Mann and B. C. Saunders, Longman, UK, 1978.
2. Vogel's Textbook of Practical Organic Chemistry (5th ed.) by A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford, P.W.G. Smith, Longman UK, 1989.
3. Analytical Chemistry, Theory and Practice, 3rd ed.. R.M. Verma, CBS Publishers, India, 1997.
4. Practical Heterocyclic Chemistry, by A. O. Fitton and R. K. Smalley, Academic Press, 1968.
5. Natural products: a laboratory guide by Raphael Ikan, Academic Press, 1991.
6. Bioassay Techniques for Drug Development by Atta-ur Rahman, M. I. Choudhary, W. Thompson, Informa Healthcare, 2001.
7. Vogels' text book of Quantitative chemical analysis byJ.mendham, RCDenny, JDBarnes, MJ KTHomas, Pearson education Ltd.
8. Vogels' text book of quantitative inorganic analysis by J. Bassett. The English language book Society and Longman.

From Bench to Bank (PGD-504)

Course description

A skill-based course for the commercialization of a lab-based innovation; how to ensure IP rights, how to plan industrial set up and start commercialization of a process or a product.

Course objectives

The objectives of this course are to;

1. Create awareness to intellectual property rights.
2. Educate students with costing of an industrial set up and commercialization.
3. Understand the key aspects pertaining to business development.
4. Apply the concepts acquired in a practical scenario.

Course contents

Module 1: Innovation management

Innovation: the creative pursuit of ideas, identifying an innovation, Intellectual property (IP) management, patents, copyright, trademark

Module 2: Entrepreneurship; Commercialization of innovation

Entrepreneurship: an evolving concept, under strategic issues in business plan development, recognizing opportunities and generating ideas, assessment of entrepreneurial plan (feasibility analysis), developing an effective business plan, cost-effectiveness, industry analysis and competitor analysis, preparing proper legal and ethical foundation, understanding the entrepreneurial perspective in person, case studies

Module 3: Organization setup

Organization setup, product design, branding, marketing, company registration, licensing, ISO certification, SWOT analysis, Law of contract, Factories act

Module 4: Understanding the entrepreneurial perspective in organizations

Corporate entrepreneurship, social entrepreneurship and the ethical challenges of entrepreneurship, pathways to entrepreneurial ventures, legal challenges for entrepreneurial ventures, sources of capital for entrepreneurial ventures, getting financing and funding, marketing challenges for entrepreneurial ventures, financial preparation for entrepreneurial ventures, strategic entrepreneurial growth, internal and external growth strategies, valuation of entrepreneurial ventures, harvesting the entrepreneurial ventures.

Teaching strategies

Lectures, slides, effective class discussions, team-based learning, quizzes, assignments, presentations by students, case studies

Assessment and examination

Sr. No	***Elements***	***Weightage***	***Details***
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Recommended Books

1. Entrepreneurship – Theory process, practice by Donald F. Koratko, 8th edition, Cenage Learning, 2013
2. Awesomely simple: Essential business strategies for turning ideas into action by Spence, John, 1st edition, Jossey-Bass, 2009
3. Zero to one: notes on startups, or how to build the future by Thieie Peter.
4. The lean startup: How today's entrepreneurship use continuous innovation to create radically successful business by R. Eric, Crown Business, 2011.
5. The art of the start 2: The time-tested, battle –hardened guide for anyone starting anything by Kawasaki Guy, Portfolio-a member of penguin group, 2014.

SEMESTER II

Green and Sustainable Chemistry (PGD-505)

Course description

The course links industry chemistry with green chemistry and sustainable development goals (SDG). Basic knowledge of green solvents ionic liquids is also included.

Course objectives

The objectives of this course are to;

1. Provide students the understanding of Green Chemistry principles
2. Focus on the attainment of Sustainable Development Goals
3. Develop critical thinking about Eco-safety and sustainability

Course contents

Module 1: Green and sustainable chemistry

Introduction to Green Chemistry, principles of Green Chemistry

Module 2: Sustainable development goals

Introduction and principles to sustainable development goals

Module 3: Utilization of renewable resources

Depletion of fossil reserves, elevation of energy demands, high energy prices, renewable resources, conversion of renewable resources into valuable chemicals and fuels, carbon-balanced economy

Module 4: Green solvents

Introduction, Supercritical fluids, low melting mixtures, Ionic Liquids (ILs), Deep Eutectic Solvents

Module 5: Ionic liquids as designer solvents

Introduction, types of ILs, applications of ILs, physical and chemical properties of ILs (viscosity, vapor pressure, melting point), thermal and electrochemical properties, conductivity and ion transport, solubility and miscibility, polarity and solvation in organic compounds and water, biphasic systems of hydrophilic ionic liquids and water, separations and extractions, extraction of organic compounds, metal ions extractions, extractive distillations, membrane separations

Teaching strategies

Lectures, slides, lab demonstration, effective class discussions, team-based learning, quizzes, assignments, presentations by students

Assessment and examination

Sr. No	***Elements***	***Weightage***	***Details***
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Recommended Books

1. Fundamentals of Ionic Liquids, from Chemistry to Applications by Douglas, R. Macfarlane, Mega Kar, and Jennifer M. Pingle. Wiley VCH, 2017.
2. An Introduction to Ionic Liquids by Micheal Freementle, Royal Society of Chemistry, 2010.
3. An Introduction to Ionic Liquids by Jason P. Hallett. Royal Society of Chemistry, 2010.
4. Utilising Biomass in Biotechnology by Helen Treichel, Gislaine Fongaro, Thamarys Scapini, Aline Frumi Camargo, Fabio Spitza Stefanski, Bruno Venturin, Springer, 2020.

Process Development and Optimization (PGD-506)

Course description

Industrial chemistry course provides a basic knowledge about linkages of chemistry, industries and environment.

Course objectives

The objectives of this course are to;

1. Develop understanding of material and energy balance calculations in Chemical Engineering
2. Enable students to analyze and solve material balance problems in processing units
3. Ensure the practices of industrial quality control

Course content

Module 1: Chemical process calculations

Units, dimensions and conversions, composition of mixtures, principles of stoichiometric combination, mass balance diagrams and tables, mass balances for items of plant, limiting and excess reactants, concepts of energy balance, Mass and Energy balance, Environmental balance, concept of integrated pollution control, health and safety

Model 2: Process design and development

General design considerations, design codes and standards, vessel design, design of mass transfer equipment, material transport, material handling, heat transfer equipment including furnaces and refrigeration units, piping and pipeline design

Module 3: Basic concepts of optimization

Optimization of unconstrained functions, linear programming applications, non-linear programming with constraints, simulation

Module 4: Industrial Management

Introduction to industrial management, productivity, plant layout, product & process layout analysis and comparison, material handling considerations in layout, production planning methods, material requirement planning, material resource planning, capacity planning and control, production control systems

Module 5: Factory Management process

Job shop scheduling, quality Control, quality assurance, production control charts, scheduling techniques, purchasing and procurement, inventory control, EOQ/EPQ models, case studies

Teaching strategies

Lectures, slides, demonstration, effective class discussions, team-based learning, quizzes, assignments, presentations by students, industrial visits

Assessment and examination

Sr. No	***Elements***	***Weightage***	***Details***
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Books Recommended

1. Peters Max S., Timmerhaus Klaus D. "Plant Design and Economics for Chemical Engineers" 4thEd. 1991. McGraw-Hill Inc.
2. Ludwig Ernest E. "Applied Process Design for Chemical and Petrochemical Plants" Vol 1, 2 & 3, 3rd Ed.2002, Gulf Publishing Company.
3. Walas Stanley M. "Chemical Process Equipment – Selection and Design "Butterworth Heinemann" 1999.
4. Coulson J. M, and Richardson, "Chemical Engineering", Vol VI, "Butterworth Heinemann" 1999.
5. Wells G. L. Rose L. M. "The art of Chemical Process Design" 1986. Elsevier.
6. Smith Robin "Chemical Process Design" 1995. McGraw-Hill Inc.
7. Backhurst & Harker, "Chemical Process Design, John Wiley
8. Evans, "Handbook of Chemical Equipment Design"
9. E. L. Cussler and G. D. Moggridge, "Chemical Product Design", 2001, Cambridge University Press

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Business Management (PGD-507)

Course description

Business management is an essential course for chemistry graduates willing to step in entrepreneurship. The course is designed to establish an integrated knowledge and ability to apply the principles of project management in the field of chemical industry and related products. Efficiently managing a business is much more important than having a striking business idea. Additionally, the course covers fundamentals of accounting and finance, behavioral and HR management.

Course objectives

The objectives of this course are to;

1. Establish integrated field knowledge and ability to apply the principles of project management in business
2. Inculcate independence and integrity
3. Provide students fundamentals of accounting and finance, behavioral and HR management.

Course outcome

- Students will be able to efficiently manage a business plan

Course contents

Module 1: Project management – Overview

Introduction to project management, definitions and nature of projects, concepts of project management, project management methodologies and organizational structures, project life-cycles, project manager, project conception and project feasibility**,** project selection, project proposal, project planning, total project planning, project scope management,

Module 2: Project management – Process

Work breakdown structure, schedules and chart, network scheduling techniques, resources planning, risk management, execution, monitoring and control, completion

Module 3: Accounting and finance

Basics of Accounting, pricing and estimation, cost management and control in projects, time value of money

Module 4: Customer focused project management

Quality in project management, principles of total quality, quality improvement tools, project effectiveness through enhanced productivity

Module 5: Behavioral management

Soft skills like communication, presentation, negotiation, fierce conversation, consumer management, project risk management, ethics in project management

Module 6: HR management

Project management through leadership, project procurement contract manager, communication manager, total quality management, ISO standards, labour and engineering laws, labour problems, Labour organizations, prevention & settlement of disputes

Teaching strategies

Lectures, slides, effective class discussions, team-based learning, quizzes, assignments, presentations by students

Assessment and examination

Sr. No	*Elements*	*Weightage*	*Details*
1.	Mid-term Assessment	35%	To be taken at the midpoint of the semester.
2.	Formative Assessment	25%	It will be continuous assessment. It includes; classroom participation, attendance, assignments and presentations, quizzes etc.
3.	Final Assessment	40%	To be taken at the end of the semester.

Recommended Books

1. Strategic project management made simple practical tools for leaders and teams by Terry Schmidt, 2009
2. Visuals for influence: in project management and beyond by Bronte Van Der Hoorn, University of Southern Queensland, 2021
3. Business writing style guide by Morris and Zwart, Oregon State University, 2020.
4. Critical employment, ethical, and legal scenarios in human resource development by Hughes, University of Arkansas, 2020.
5. Financial management for small businesses: Financial statements & present value models by Robinson, Hanson and Black, Michigan State University, 2020.

Project/ Internship (PGD-508)

Graduates will be provided with the opportunity to do an internship in any industry to apply their knowledge obtained through this diploma.

Eligibility qualification:

Graduates who have completed 16 years of education with Chemical Science background.

Number of seats:

The number of seats will be decided by committee approved by Academic council, the tentative number is 40 seats.

Proposed Fee Structure

Centre for Research in Ionic Liquids

PGD "Chemisrtry and Entrepreneurship" (Self Supporting/Semester System)

	Semester	
	1st	2nd
I. Fee		
Admission Fee	300	300
Tuition Fee	32000	32000
Breakage Fee	1000	1000
1.Fee Total	33300	33300
2.Services		
Bus Pass Charges	1990	1990
Examination Fee	4400	4400
P.U. Dev. Fund	500	
Sports Fund (PUTDSA)	200	
Field Work	1000	1000
2.Service Total	8090	7390
3.Utilities		
Electricity Charges	910	910
P.U. Internet Facility	970	970
3.Utilities Total	1880	1880
4. Departmental Dues		
Departmental Dues	10000	10000
4.Departmental Dues Total	10000	10000
G. Total	**53270**	**52570**