

CIRCULAR :-

No.UG/325 of 2007.

Mumbai 400 032,

21st July, 2007.

The Director,
Garware Institute of Career
Education and Development,
Vidyanagari Parisar,
Kalina, Santacruz(East),
MUMBAI 400 098.

Sir, I am to inform you that the recommendation made by the Advisory Committee of Garware Institute of Career Education and Development at its meeting held on 22nd May, 2007 has been accepted by the Academic Council at its meeting held on 12th June, 2007 vide item No.7.2 and subsequently approved by the Management Council at its meeting held on 15th June, 2007 vide item No.17 and that, in accordance therewith, Two Year Post-Graduate Diploma in Analytical Techniques conducted at your Institute has been instituted by the University from the academic year 2007-2008.

Further that in exercise of the powers conferred upon the Management Council under Section 54(1) and Section 55(1) of the Maharashtra Universities Act 1994, it has made the Ordinances 5717 and 5718 and Regulations 5755, 5756, 5757, 5758 and 5759 including syllabus relating to the Two Year Post-Graduate Diploma in Analytical Techniques is passed as per Appendix* and that the same has been brought into force with effect from the academic year 2007-2008.

Yours faithfully,

for I/c REGISTRAR

A.C.7.2/12.06.2007

M.C.17/15.06.2007

Copy to :-
The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Personal Assistant to the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information

The Officer on Special Duty and Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director, University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar (PRO), the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Constituent Colleges Unit (2 copies), BUCT (1 copy), the Deputy Account Unit V (1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post Graduate Section (2 copies) and the Superintendent, Thesis Section (2 copies).

UNIVERSITY OF MUMBAI
ORDINANCE, REGULATIONS AND SYLLABUS
RELATING TO THE

P.G. DIPLOMA IN ANALYTICAL
TECHNIQUES

CONDUCTED BY THE
GARWARE INSTITUTE OF CAREER EDUCATION
AND DEVELOPMENT

(w.e.f. Academic Year 2007-2008.)

UNIVERSITY OF MUMBAI
GARWARE INSTITUTE OF CAREER EDUCATION AND DEVELOPMENT
ORDINANCES, REGULATIONS AND SYLLABUS
RELATING TO THE

Two-Year Full Time P.G. DIPLOMA IN ANALYTICAL TECHNIQUES

Preamble:

Domestic and International Chemical and Pharmaceutical market is becoming very competitive. It is imperative that chemical industry, pharmaceutical and biotechnology companies, and contract research institutions develop and manufacture products efficiently to meet domestic and international demand ensuring compliance to regulatory and statutory requirements. The activities in the area of Contract Research and Environment, Health and Safety (E H & S) are also expanding its base in India, recognizing the vast knowledge base and expertise available. This requires well-prepared personnel to work in the field of analytical techniques whose role is crucial. This course is developed to cover knowledge base in science, technological concepts, environmental factors involved in analytical processes from R & D to marketing.

Objective of the Programme :

Aimed at preparing candidates for positions in industry using analytical techniques used in R&D, quality control, regulatory functions in Pharmaceuticals and Chemical companies, Contract Research Laboratories etc.

UNIVERSITY OF MUMBAI
ORDINANCES, REGULATIONS AND SYLLABUS RELATING TO THE
P.G. DIPLOMA IN ANALYTICAL TECHNIQUES
CONDUCTED BY THE
GARWARE INSTITUTE OF CAREER EDUCATION AND DEVELOPMENT

O. 5717 TITLE OF THE COURSE :
P.G. DIPLOMA IN ANALYTICAL TECHNIQUES

O. 5718 ELIGIBILITY:
B.Sc. with chemistry upto SY level OR B.Pharm. OR equivalent
thereto

R. 5755 DURATION OF THE COURSE :
2 YEARS' FULL TIME 4 SEMESTERS

R. 5756 INTAKE CAPACITY:
40 PER BATCH (FORTY NUMBERS PER BATCH)

R. 5757 SELECTION PROCEDURE:
ADMISSION ON THE BASIS OF MARKS & A PERSONAL INTERVIEW.

R. 5758 FACULTY :
EXPERTS IN THE FIELD.

SEMESTER WISE – EXAMINATION PATTERN

TOTAL MARKS: 2300

Detailed Syllabus Semester-wise Plan

PAPER	SUBJECT	MARKS	CREDITS*
	SEMESTER I		
1	TOOLS OF ANALYTICAL CHEMISTRY	100	3
2	CLASSICAL & ELECTROCHEMICAL METHODS	100	4
3	MOLECULAR SPECTROSCOPY	100	4
4	ATOMIC SPECTROSCOPY	100	4
5	CHROMATOGRAPHY TECHNIQUES	100	6
6	INFORMATION TECHNOLOGY	100	2
			23
	SEMESTER II		
7	STATISTICS	100	3
8	QUALITY CONTROL & ASSURANCE	100	3
9	ADVANCED ANALYTICAL TECHNIQUES	100	6
10	MARKETING & SALES	100	3
11	PRINCIPLES OF MANAGEMENT	100	3
12	GENETICS & BIOTECHNOLOGY ANALYTICAL TECHNIQUES	100	4
			22
	SEMESTER III		
13	ENVIRONMENTAL HEALTH & SAFETY	100	3
14	FINANCE & ACCOUNTS	100	3
15	APPLICATION IN FOODS	100	3
16	DIAGNOSTICS CLINICAL BIOCHEMISTRY	100	3
17	APPLICATION IN PHARMA & ALLIED	100	4
18	APPLICATION IN POLYMERS	100	3
19	METHOD DEVELOPMENT & VALIDATION	100	3
			22
	SEMESTER IV		
20	PRACTICALS	200	8
21	PROJECTS / TRAINING	300	12
			20
	TOTAL	2400	87

*1 CREDIT IS 15 CONTACT HOURS

Notes:

- 60% of the marks for internal evaluation for Progressive Evaluation with tests/ projects / seminars etc & 40% marks for Final Evaluation
- Practicals will be spread over four semesters, evaluated progressively but credited in fourth semester

DETAILED SYLLABUS

The techniques given in subjects/papers will be covered on following lines:
Principles, instrumentation, application and illustrative examples in industry

SEMESTER I

PAPER	SUBJECT
1	TOOLS OF ANALYTICAL CHEMISTRY Chemicals, Apparatus, and Unit Operations of analytical Chemistry Using Spreadsheets in Analytical Chemistry Calculations Used in Analytical Chemistry Errors in Chemical Analysis Statistical Data Treatment and Evaluation Sampling, Standardization and Calibration Concepts of Analytical Chemistry. Detectors, Transducers and Sensors References 1) Principles of Instrumental Analysis: Skoog, Holler, Niemen 2) Instrumental Methods Analysis: Willard, Merritt Dean, Settle 3) Fundamentals of Analytical Chemistry: Skoog, West, Holler, Crouch 4) Handbook of Instrumental Techniques: Frank Settle: Pearson Education, Delhi
2	CLASSICAL & ELECTROCHEMICAL METHODS OF ANALYSIS Gravimetric Methods – Precipitation Gravimetric – Colloidal Precipitate, Crystalline Precipitate, Co-Precipitation, Precipitation from Homogeneous solution, Calculation of results from Gravimetric data, applications of Gravimetric Methods Volumetric Methods – Calculations of Molarity, Molality, Normality and Equivalent weight, Primary standards, Secondary standards, etc Acid- Base Titrations – Involvement strong or weak acids or Bases Ionic Equilibrium, Titration Curves and Choices of Indicators Precipitation Titrations – Theory, Detection of End Point, Adsorptions Indicators, and Titration Curves of Chlorides with Silver Nitrate, Sulphates with Barium Redox Titration – Theory, Oxidation Reduction Reactions, Choice of Indicators, Titration involving Iodine (Iodimetric), Oxidizing agent (KMnO_4 & $\text{K}_2\text{Cr}_2\text{O}_7$) Reducing agent (Thiosulphate & Fe II) Complexometric Titration – Formation of Complexes, Types of Coordination Compound, EDTA Titration - Direct Titration, Back Titration and Displacement Titration, Organic Complexing Agents Non Aqueous Titration Recapitulation- The hydrogen scale, electrode potentials, effect of current on cell potentials, reference electrodes, indicator electrodes instrument for measuring cell potentials. Ion selective potentiometry- Solid state, precipitate and liquid-liquid membrane, enzyme and gas sensing electrodes with applications. Electrolytic methods- Current- voltage relationships during electrolysis Electrogravimetry & Coulometry at controlled potential and controlled current Voltammetry - Polarographic wave equation, effect of complex formation on polarographic waves, Ilkovic equation: derivation starting with Cottrell equation. Applications of polarography including organic analysis. An introduction to modern voltammetric techniques viz. differential pulse polarography, cyclic voltammetry and stripping (cathodic & anodic) voltammetry. Amperometric titrations with one and two micropolarized electrodes: theory, apparatus and applications including Karl Fischer titration.
3	MOLECULAR SPECTROSCOPY Introduction to Spectrometry Electromagnetic Radiation: Scattering, Interference, Diffraction, Polarization, Photoelectric effect Spectra: Line, Band, Continuum UV & Visible Spectrometry Measurement of transmittance and absorbance, Beer's Law, Noise effects on Analysis Visible, UV Absorption, Single and Double beam, Double dispersing, Diode array instruments Molar Absorptivities, types of absorbing electrons, Organic chromophores,

	absorption by transition metal series, Charge transfer absorption, Qualitative and Quantitative analysis with absorption measurements, Analysis of mixtures, Photometric Titrations Theory of Fluorescence and Phosphorescence, Emission and excitation spectra, Fluorimeters and Spectrofluorimeters Phosphorimetric methods, Application in Inorganic and organic species Application of Phosphorimetry and flurometry in LC Chemi-luminance Infra red spectrometry Theory of infra red absorption spectrometry, Vibrational modes, Sources and transducers, Instruments FTIR spectrometers Dispersive and non-dispersive instruments Applications: Aromatic hydrocarbons, air contaminants etc Near and Far Infra red spectrometry Raman Spectroscopy: Raman Scattering, Wave model, Raman spectrometers, Applications in inorganic and organic species
4	ATOMIC SPECTROSCOPY Atomic Absorption Spectrometry Elemental Analysis (eg C, H, N, O, S, P, Halogens) Optical Atomic Spectra: Emission, Absorption, Fluorescence Spectra, Band Continuum Sample introduction methods Flame Atomization, Electrothermal Atomizers, Glow Discharge Atomization, Radiation Sources Spectrophotometers, Interferences and Corrections, Equilibria Atomic Absorption Spectrometry Sample Preparation, Calibration, Applications Atomic Fluorescence Spectroscopy, Emission Spectroscopy based on Plasma Sources, ICP(Inductively Coupled Plasma) Spectrometry Fourier Transform Spectrometers Emission Spectroscopy based on Arc and Spark sources Absorption Spectra X-ray Fluorescence :Wavelength and Dispersion Transducers and Signal processors, Energy Dispersive and non-dispersive instruments, Analysis
5	CHROMATOGRAPHY TECHNIQUES Introduction and Theory of chromatography Elution Chromatography: Migration rates of solutes, Zone broadening and column efficiency, Optimization of column performance, Relationship between important parameters, Applications of Chromatography Gas Liquid Chromatograph: Principles, Instruments: Carrier gas supply, Sample injection Columns, Detection systems: Packed columns, Adsorption, Stationary phases Applications of GC: Qualitative and Quantitative High Performance LC Scope, Column efficiency, Instruments: mobile phase reservoirs and sample treatment systems, Pumping systems, Sample injection, Columns Detectors : Absorbance, Fluorescence, Refractive index, evaporative light scattering, Electrochemical types Partition Chromatography Bonded phase , Mobile phase techniques Applications of partition chromatography: Derivative formation, Ion-pair, chiral stationary phase Adsorption chromatography: Ion exchange chromatography: organic, inorganic and biochemical applications Ion & Size exclusion chromatography Thin Layer chromatography: technique, performance and applications
6	INFORMATION TECHNOLOGY WORD, EXCEL, MS: PROJECT MANAGEMENT. IT Systems in Industry: ERPs, Networking, Telecom networks, Operating systems, / Database management: only introduction to functionality.

Performance monitoring through Budgets and MIS
 Security in IT, electronic Signature,
 Selection criterion, vendors, and deployment.
 Networking of of Analytical equipments
 Review of LIS Software
 Project on Databases with their specializations.
 Mastering Microsoft Office XP Premium Edition: Courter, Gini &c

SEMESTER II

7	STATISTICS Introduction: Mean spread, deviation, grouped data, graphical representation Probability, Discrete probability distributions: Binomial & Poisson Distribution Continuous Distributions: Standard Normal distribution, Normal approximations to discrete distributions Estimation: Relationship between Population and sample, Random number tables, Randomised experiments Hypothesis Testing: One sample reference: test for mean, sample size determination, relationship between hypothesis testing and confidence intervals, Chi square test for variance of a normal distribution, one sample test for Binomial & Poisson distribution Research Methodology Sampling Different Methods their merits and Demerits Design of Hypothesis: Hypothesis testing: Two sample inference: Paired t test, One way analysis of variance: ANOVA: Fixed effects, comparison of groups, Non parametric methods, Two-way analysis of variance Regression and correlation methods, Fitting, least squares, correlation coefficient, multiple logistics regression Study design, methods of inference for stratified data: Mantel-Haenszel Test Theory and Problems of Statistics: Murray R Spiegel & Larry J Stephans Statistics for Management: RI Levin & DS Rubin
8	QUALITY CONTROL AND ASSURANCE SYSTEMS Quality Systems Standards, Standardization, Calibration, Reference / Working Standards, ISO 9000 and others, CGMP Standards, Indian Pharmacopoeia, Drugs and Cosmetics Act 1940 and Rules there under, US FDA Requirements, EU requirements, ICH guidelines PFA 1954 (foods) Statistical Process Control Process Quality and Control Limits Good Documentation Practices, Change Control Management, Out Of Specifications (OOS), Deviation Reporting, Stability Studies Implementation process of Accreditation of analytical lab History of Quality Systems: Japanese and US origins Quality Circles, Total Quality Management, Six Sigma Implementations
9	ADVANCED ANALYTICAL TECHNIQUES Theory of NMR FT, Pulse excitation, Free induction decay, Environmental effects, Theory of chemical shift, Spin-spin splitting, First and second order spectra, Double resonance techniques, NMR Spectrometers, Proton NMR MR Imaging Molecular Mass Spectrometry Double Focus and Quadrupole MS, FT Applications of mass spectrometry: identification, structure Thermal Analysis, Differential Thermal Analysis, Thermometric Titrimetry Differential Scanning Calorimetry, Thermo Gravimetry, Particle Size Analysis Hyphenated Analytical Techniques and Applications GC-MS, LC-MS, ICP-MS, GC-FTIR, TG-FTIR X-ray Diffraction, Interpretation of Diffractograms of elements and compounds
10	MARKETING & SALES Concepts of present day marketing, Developing strategies and plans. Customer Satisfaction and Customer Orientation of organization as a whole. Market Research: Secondary, Primary. Demand Forecasting, Analysing markets, Segmentation Creating Brand Equity,

	Competition and Strategy, Product Strategy, Pricing Strategies Distribution, Channel Management Decisions Marketing Communication: Advertising, Promotion, Publicity, Personal Selling, Direct Marketing, Event Marketing Product Planning: Marketing plan Marketing Budgets: investments, recurring, MIS INTERNATIONAL MARKETING Regional Economic Size: GDP, Trade Patterns, Development of Trade in international scenario. MNCs, Cultural Environment, Attitudes and practices, Free Trade & Controls, GATT: Trade and protection effect, Non-tariff Barriers, Trading framework, Anti dumping IMF, World Bank, Tax havens Opportunities in Developing and Developed countries Strategy for entry in international markets Joint ventures, Mergers & Acquisitions Philip Kotler: Marketing
11	PRINCIPLES OF MANAGEMENT Functions of Manager Evolution of Management thought, Behavioural Sciences Value System – integrity, customer satisfaction, Innovation, etc Planning Purpose, steps, process, Objectives, MBO, Developing verifiable goals Strategy, Policy, Decision Making Organising Structure, Departmentation, Span Environment- entrepreneurial innovation Line, Staff, Authority, Decentralisation, Delegation Leading Human Factor and Motivation Motivational Theories, Strategic Approaches, Special Motivational Techniques Quality of life, Job enrichment, career advancement, management participation Leadership Definition, Leadership styles Committees & Group Decision making Communication Process, Barriers, Effective communication Controlling Process, Control points, Benchmarks, standards, Feedback system, Requirements of a good control system Koontz, Harold and Weirich, Heinz : Essentials of Management : an Indian perspective Weirich Heinz and Koontz, Harold : Management : a global perspective Koontz, Harold & others : Principles of Management Drucker Peter F : Management : Tasks, Responsibilities and Practice
12	GENETICS & BIOTECHNOLOGY ANALYTICAL TECHNIQUES Structure of cell, Chromosome structure, DNA & RNA Composition and structure Proteins Composition and Structure DNA Replication, Recombination, Repair RNA Transcription Recombinant DNA and Technology Mitochondrial DNA, Genetic Code, Transcription, Mutations, Structural and Functional Effects on protein, Chromosome preparation, banding, Karyotype analysis, Fluorescent in situ Hybridization(FISH), Flow Cytometry Protein and Peptide Analysis Chromatography: column, Partition, Size exclusion, absorption, ion exchange, affinity Electrophoresis: 1 D, 2 D Mass Spectrometry Matrix Assisted Laser Desorption MALDI-TOF, MALDI TOF/TOF, MALDI-QTOF Electro Spray Dispersion: ESI-QTOF, ESI-ION TRAP, SELDI-TOF Databases: 2D Page, Mascot Peptide, Swiss Prot etc. Human Genome Project, Objectives, Sequencing human genome, Comparative genomics, Functional genomics, Ethical Legal and Social issues, Pros and Cons of the Genome project Emery's Elements of Medical Genetics: PD Turnpenny & Sian Ellard

13	ENVIRONMENTAL HEALTH & SAFETY Environmental pollution – sources effects and monitoring Waste Management strategies-water and waste-water treatment, waste-management options for prevention & control of emissions covering control equipments for particulate & gaseous emissions, solid waste management including hazardous & Bio-medical wastes Environmental Legislations policy and planning Environmental protection act & Rules under that Environmental management systems, Concepts of EIA, Procedures, and methodologies. EMP & DMP needs with HAZEN& HAZOP studies. ISO 14000 Industrial safety, Occupational health, Personal Protective equipments Risk Assessment
14	FINANCE & ACCOUNTS Introduction to Accounting Practices, Capital Investments, Structure, ROI Balance Sheet and Profit & Loss Account, Ratio Analysis Product, Process and Batch Costing Inventory Management Working Capital Requirements Project Preparation, Sensitivity Analysis Forecasting Demand IT in Accounting, MIS (Management Information System) Khan M. Y. & Jain, P. K.: Financial Management Text, Problems & Cases Prasanna, Chandra : Financial Management
15	APPLICATIONS IN FOODS, NEUTRACEUTICALS Legislation of Food and Drugs Norms, Rules, Regulations Food Additives, Food Preservatives, Anti-oxidants, Emulsifiers and Stabilizers, Improvers and Bleaching agents, Artificial Sweetening agents, Role of Permitted colours, characteristics Oils and Fats : Analysis, determination of impurities & composition of oils and fats Determination of saturated and unsaturated fatty acids. Unsaturation of fatty acids Test of Rancidity, acid value, iodine value Adulterants: Tests for Paraffin oil, Cotton seed oil, Beef Tallow. Saw dust in chili and condiment powders / masala, used and unused tea leaves in fresh tea dust/leaves, non-permitted food colours Water purification. Pesticides content in food: DDT, BHC Determination of calorific value of foods Composition of Macronutrients in diet. Effect on serum cholesterol. Poly unsaturated fatty acids and risk factors, Metabolic Adaptation. Relationship between carbohydrate intake and Serum Triglycerols Glycemic Index and Load Role of Micronutrients in diet and supplements, Assessment of nutritional status in clinical practice, nutritional needs of elderly persons
16	DIAGNOSTICS CLINICAL BIOCHEMISTRY Tests, standard limits, interpretation, elementary diagnostics Automated Equipments for measurements Essential Tests for medical diagnostics Blood, urine, stool, sputum, tissue analysis HbA1c, Lipid Profile, Liver Profile Thyroid Profile, Renal Profile, Iron Deficiency Profile Infectious diseases detection. Hepatitis B surface Antigen, Hepatitis C Virus Antibodies Kidney, Cardiac Risk Markers Blood Groups, Fractionation Microbiology sample preparation growths and Tests Text book of Biochemistry. TM Devlin Harper's Illustrated Biochemistry. Murray, Granner, Mayes, Rowell

17	APPLICATION IN PHARMA & ALLIED Drugs and Pharmaceuticals Act, Current GMP Pharmacopeial Standards Indian, US, British Assay of drugs: Vitamin C, B2, Aspirin, Ibuprofen, Streptomycin, Sulphadiazene Limit Tests in pharma substances Specificity and Sensitivity of limit tests Limits of moisture, volatile matter, residual solvents, non-volatile matters, detection of impurities in organic substances and limits Application of Analytical Techniques illustrated with examples in pharma production, QC, Development
18	APPLICATIONS IN POLYMER INDUSTRY Classification and nomenclature, intermolecular forces, chemical structure Identification and Characterization of polymers using IR, ESR, NMR, XRD Thermal analysis, microscopy, physical properties, electrical properties, mechanical behaviour Properties of commercially important polymers: Polyolefins, ABS, vinyl, acrylic, fluoropolymers, silicones, specialty polymers Fillers, Reinforcements, Flame retardants, Elastomers, Fibers, Plastics production, processing, applications Application of Analytical Techniques illustrated with examples in polymer facilities in production, QC, Development Petroleum Industry, Dyes, Chemicals and Intermediates as topics
19	METHOD DEVELOPMENT & VALIDATION Validation Master Plan Design Qualification; Installation Qualification, Operational Qualification Performance Qualification; Method Validation Instrument Calibration; Computer System Validation Preventive Maintenance Schedule Diagnostics for Service – Trouble Shooting Routines / Algorithms .

SEMESTER IV

Following list gives suggested list of practicals. Suitable modifications may be made when necessary. Around 20 numbers of practicals are needed to be completed

PAPER	SUBJECT
20	PRACTICALS
Number	Title / Content
	NON-INSTRUMENTAL
1	Calibration of glassware
2	Separation using solvent extraction with ethyle acetate eg of Fe, Mg/Zn
3	Determination of persulphate by redox titration using ferrous ammonium sulphate and potassium permanganate
4	Estimation of Vitamin C by titration with potassium bromate
5	Determination of Ca and Mg in Dolomite
6	Separation by column chromatography eg Chloroquin or other
7	Separation by paper chromatography using food colours
8	Colour comparison Techniques Lovi Bond Comparator
	INSTRUMENTAL

9	Auto titration
10	Coulometric titration
11	Karl Fisher Method
12	Determination of glucose by Folin Wu method in honey and / Oral Rehydration Solution
13	UV-VIS spectrometry Wavelength calibration as per Pharmacopoeia
14	UV-VIS spectrometry. Determination of fluoride in toothpaste
16	UV-VIS spectrometry. Determination of Chromium and Manganese
17	FTIR : Calibration using polystyrene calibrator, Solid sample preparation, Liquid sample preparation, Test, Qualitative analysis
18	Flame Photometer: Determination of Na, K
19	Atomic Absorption Spectrometer: Estimation of Pb and Cd
20	Gas Chromatograph: Gas analysis of eg Butane, Liquid Analysis from mixture of say Benzene, Xylene, Toluene
21	HPLC Calibration, Separation eg of Vitamins
22	Ion Chromatography Separation of Anions, Separation of Cations
	LIVE DEMONSTRATIONS
23	GCMS Residual solvent in API
24	LCMS Quantitative analysis of a pharma compound or pesticide
25	LCMS Qualitative analysis and structural elucidation of a pharma compound like Reserpine
26	Thermal Analysis: Determination of polymorphic form of API
27	Thermo-gravimetric analysis of a mineral eg carbonate, copper sulphate
28	XRD: Analysis of a mineral: eg Cement, or Lime stone
29	Electrophoresis ; MALDI TOF :Separation of Amino acid / protein
30	ELISA Assay
31	Peptide synthesis
32	NMR: demonstration pharma application
33	Raman FTIR: demonstration pharma application
34	ICP: Demonstration
35	Optical Microscope / Confocal Microscope / Electron Microscope : Demonstration
PAPER	SUBJECT
21	PROJECTS / TRAINING A report on project with industry will be submitted by students based upon work covered over 3 months. Marks will be based upon project evaluation & viva-voce.

R. 5759 STANDARD OF PASSING

1. Students will have to attend the classes regularly to complete the PG Diploma course. Student should have 75% attendance.
2. The minimum percentage required for passing will be 50% in each paper.
3. A student failing in maximum two subjects can move to next semester and clear these subjects in supplementary examination held before the next semester regular exam. Student failing in more than two subjects can appear in supplementary examination in all subjects but cannot go to the next semester
4. CGPA Grades will be awarded in line with Credit System:

Marks	Grade Point	Letter Grade
75-100	7.5-10.0	O
65-74	6.5-7.49	A+
60-64	6.0-6.49	A
55-59	5.5-5.99	B+
50-54	5.0-5.49	B
0-49	0.0-4.9	F