ANNEXURE - XIII

MASTER OF BUSINESS ADMINISTRATION

MGO-6101

PRINCIPALS AND PRACTICES OF MANAGEMENT

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Registrar
Mangalayatan University
Beswan, Aligarh

Block:I Introduction

Unit: 1 Introduction: Meaning, Nature and Scope of Management, Management Approaches, Processes and Functions,

Unit: 2 Managerial Skills, Tasks and Responsibilities of a Professional Manager;

Unit: 3 Evolution of Management Thought, Taylor and Fayol' contribution to Management, Bureaucracy, Hawthorne Studies; Management thinkers,

Block:II Planning

Unit: 4 The Nature and Purpose of Planning, Management by Objectives, Strategies, Policies and Planning Premises. Forecasting.

Unit: 5 Decision Making; Organizing: Nature & Purpose of Organizing. Span of Management,

Unit: 6 Departmentation, Line/ Staff Authority & Responsibility, Effective Organizing & Organizational Culture, Organization Charts and Manuals.

Block: III Staffing

Unit: 7 Staffing: Definition, Nature and Purpose of Staffing

Unit: 8 Human Resource Management and Selection, Performance Appraisal and Career Strategy

Unit: 9 Manager and Organization Development: Managing Change, Organizational Conflicts.

Block: IV Leadership

Unit: 10 Leading: Managing and the Human Factor.

Unit: 11 Motivation: Meaning, Scope and Importance, Approaches, Motivation and Performance, Approaches for Improving Motivation, Quality of Work Life;

Unit: 12 Leadership: Definition, Ingredients, Approaches;

Unit: 13 Communication: Function, Process and Barriers to Communication;

Unit 14: Directing- Meaning, Nature and Scope, Direction and Supervision.

Block: V Controlling

Unit: 15 Controlling: Concept, the System and Process of Control, Control Techniques and IT, Productivity and Operations Control;

Unit: 16 Controlling Methods: Budgetary and non- budgetary, Overall and Preventive Control.

Unit: 17 The Quality Concept Factors affecting Quality, Developing a Quality Control System, Total Quality Control;

Unit 18: International Management: Towards a unified, global Management Theory

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MANAGERIAL ECONOMICS

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Block I: Introduction to Managerial Economics Unit
1:Basic concepts and principles of Economics,
Unit 2: Introduction to Managerial Economics: Nature, Scope,
Unit3: Importance and Significance in decision making, Managerial Economist-Role, responsibilities and functions.

Block II: Demand, Supply and Revenue Analysis Unit
4: Demand & supply analysis,
Unit 5: Consumer Preferences and choices.
Unit 6: Demand Elasticity;
Unit 7: Types & its relevance, demand forecasting, revenue analysis.

Block III: Production & Cost Analysis
Unit 8: Cost: Concepts, measurement & analysis,
Unit 9: Production Function & its managerial applications,
Unit 10: Cost curves: traditional & modern approach,
Unit 11: Production Function; Laws of returns.

Block IV: Pricing Decisions & Profit Planning
Unit 12: Market Structures, pricing under different market structures,
Unit 13: Perfect, imperfect and monopoly,
Unit 14: Break Even Analysis; Profit Planning;
Unit 15: Oligopoly (Cournot's model, kinked demand curve model, prisoner's dilemma).

Block V: Macro Economics
Unit 16: Concepts of national Income and methods of its measurement,
Unit 17: Inflation: Theories,
Unit 18: Introduction to business cycles

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MASTER OF BUSINESS ADMINISTRATION

MGO-6103

ACCOUNTING FOR MANAGERS

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Block I: Accounting Framework I (Introduction to Accounting)
Unit 1: Introduction, Nature, scope and importance of Accounting, Book Keeping,
Unit 2: Accounting Process, Users of an Accounting information and their needs,
Unit 3: Accounting Equation, Role and Responsibilities of an Accountant; GAAP and Accounting Standards-Indian and international.

Block II: Accounting Framework II (Accounting Books and Final Accounts) Unit 4: Preparation of Journal, Ledger, Trial balance,
Unit 5: Cash book & other subsidiary books,
Unit 6: Preparation of Trading, Profit & Loss A/c and balance Sheet (with adjustments),
Unit 7: Depreciation Accounting and
Unit 8: Preparation of BRS.

Block III: Cost Accounting
Unit 9: Meaning, importance of Cost Accounting,
Unit 10: Elements and classification of costs and Preparation cost sheet,
Unit 11: Inventory valuation.

Block IV: Management Accounting
Unit 12: Meaning, importance of Management Accounting,
Unit 13: Budgeting & Budgetary Control;
Unit 14: Preparation of Fixed & Flexible budget, Zero Based Budgeting.

Block V: Financial Statements Analysis
Unit 15: Meaning, importance of financial statement,
Unit 16: Ratio Analysis,
Unit 17: Preparation and Analysis of Fund Flow
Unit18: Cash Flow Statements according to AS-3.

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BUSINESS STATISTICS

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Block I: Introduction

Unit 1: Meaning and definitions of Statistical Data; Applications of Statistics in Managerial decision- making;
Unit 2: Frequency Distributions; Measures of Central Tendency: Mean, Median, Mode and their implications;
Unit 3: Measures of Dispersion: Range, Quartile Deviation, Mean Deviation and Standard Deviation.

Block II: Correlation and Regression

Unit 4: Meaning and uses of correlation
Unit 5: Meaning and uses of regression.
Unit 6: Various methods of calculation of Coefficient of correlation and their analysis (Two Variable)
Unit 7: Regression analysis.

Block III: Analysis of Time Series

Unit 8: Concept; Additive model, Multiplication model,
Unit 10: Seasonal variation, Cyclical Variation;
Unit 11: Various methods of Time Series Analysis and their applications in business.

Block IV: Probability

Unit 12: Concept, its uses in business decision-making,
Unit 13: Addition and multiplication theorem of probability; Binomial theorem and its applications
Unit 14: Probability Distribution: Concept, applications of Binomial, Poisson and Normal Distributions.

Block-V:Estimation Theory and Hypothesis Testing

Unit 15: Estimation Theory and Hypothesis Testing: Sampling theory; Formulation of Hypotheses;
Unit 16: Application of Z-test, t-test,
Unit 17:F-test and ANOVA
Unit 18: Chi-Square test. Techniques of association of Attributes & Testing.

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COMMUNCIATION FOR MANAGEMENT

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Block I:Introducing Business Communication

Unit 1: Basic forms of communication; Self Development and CommunicationDevelopment of positive personal attitude
Unit: 2 Communication models and processes; Self Development and CommunicationDevelopment of positive personal attitude; Corporate
Unit3: Audience analysis Principles of effective communication, formal and informal communication networks, Grapevine, miscommunication (barriers).

Block II:Effective listening

Unit 4: Principles of effective listening; Factors affecting listening exercise;
Unit 5: Oral, written and video sessions.
Unit 6: Modern forms of communicating:
Unit 7: Fax: E-Mail; Video conferencing etc. nonverbal aspects of communication, Kinesics, Proxemics, Para language, sign language.

Block III:Writing skills

Unit 8: Planning business message; rewriting and editing; the first draft;reconstructing the final draft. **Unit 9: Business** letters; Appearance of request letters; Good news and bad news letters; Persuasive letters;
Unit 10: Sales letters; Collection letters; Office memorandum, notice and circular.
Unit 11: Writing resume and letter of application.

Block IV:Report writing

Unit 12: Introduction to a proposal, short report and formal report, report preparation,
Unit 13: Sales presentation, training presentation,
Unit 14: Conducting surveys, speeches to motivate.

Block V:Practices in business communication

Unit 15: Group discussions; Mock interviews; Seminars; Effective listening exercises;
Unit 16: Individual and group presentations, Oral presentation:
Unit 17: Principles of oral presentation, Factors affecting presentation,
Unit 18: Interviewing skills: Appearing in interviews; conducting interviews

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ENTREPRENEURSHIP & SMEs MANAGEMENT

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Block I: Entrepreneurship: A Conceptual Framework

Unit 1: Introduction: Concept of Entrepreneurship; Role of entrepreneurship in economic Development; **Unit 2:** Factors impacting emergence of entrepreneurship; Managerial vs. entrepreneurial approach; Intrapreneurship.
Unit 3: Types of Entrepreneurs. Characteristic of successful entrepreneurs; Entrepreneurship process;
Unit 4: Women Entrepreneurs; Social entrepreneurship; Entrepreneurial challenges.

Block II: Entrepreneurial Growth:

Unit 5: Role of Entrepreneurship in Economic Development, Entrepreneurial Theories; Factors affecting entrepreneurial growth
Unit 6: Entrepreneurial Challenges; New Product
Unit 7: Development and Growth Strategies for Entrepreneurial ventures.

Block III: New Ventures Planning

Unit 7: Ownership Structures; Acquisition; Franchising, Marketing plan, **Unit 8:**Marketing research, Marketing Mix; Business Plan-benefits of drivers **Unit 9:** Perspectives in business plan preparation, elements of a business plan.

Block IV: MSME Registration and Promotion

Unit 10: MSME registration, MUDRA Loan,Start-up India. **Unit 11:**Make In India, Institutional Finance to Entrepreneurs **Unit 12:**MSME and Economic Development,
Unit 13: Institutional Support for Small Enterprises.

Block V: International Entrepreneurship:

Unit 14: Export Business Registration, Intellectual Property Protection- Patents,
Unit 15: Trademarks and Copyrights – importance for start-ups,
Unit 16: Legal acts governing business in India;
Unit 17: International entrepreneurship- opportunities and challenges,
Unit 18: Export Documentation in India.

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BUSINESS ENVIRONMENT

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Block I: Theoretical Framework of Business Environment Unit 1:
Concept, Significance, of Business Environment **Unit 2:** Nature, Elements & Dimensions;
Unit 3: Environmental Scanning and Monitoring.

Block II: Economic Environment of Business
Unit 4: Significance and Elements; Economic Systems; Economic planning in India; Government Policies- Industrial,
Unit 5: Fiscal, Monetary, EXIM; Public Sector and economic development; Development banks and its relevance to Indian business;
Unit 6: Economic Reforms, Liberalization and structural adjustment programmes;
Unit 7: Regulation of Financial Markets, SEBI.

Block III: Political and Legal Environment of Business Unit 8:
Critical elements; Government and business;
Unit 9: Changing dimensions of political and legal environment in India;
Unit 10: MRTP Act, Competition Act, FEMA and licensing policy
Unit 11: Consumer Protection Act.

Block IV: Socio-cultural Environment
Unit 12: Social institutions, systems, values, attitudes, groups, etc;
Unit 13: Dualism in Indian society and problems of uneven income distribution;
Unit 14: Rural sector in India; Social Responsibility of Business; Consumerism in India.

Block V: International and Technological Environment
Unit 15: Multinational Corporations; Foreign collaborations and Indian business; NRIs and Corporate sector
Unit 16: International Economic Institutions- WTO, World Bank, IMF and their importance to India; Foreign trade Policies;
Unit 17: Impact of Rupee devaluation; Technological environment in India; Policy on research and development
Unit 18: Intellectual Property Rights; Technology transfer.

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RESEARCH METHODOLOGY

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Block I: Research Formulation

Unit 1: Introduction, meaning of research,
Unit 2: Types, Role of research in important area and Process of Research,
Unit 3: Defining research Problems, Hypothesis Formulation.

Block II: Research Elaborated

Unit 4: Research Design, Research plan,
Unit 5: Concept of sample, Sample size, Various types of sampling techniques.
Unit 6: Types of Data and Methods of its Collection; Questionnaire Design,
Unit 7: Precautions in preparation of questionnaire, Measurement scales.
Block III: Data Analysis and Interpretation-1

Unit 8: Processing and Analysis of Data by application of statistical tools,
Unit 9: Various kinds of charts and diagrams used in data analyses
Unit 10: Application of Data Analysis.

Block IV: Data Analysis and Interpretation-2

Unit 11: Hypothesis Testing (F-test, ANOVA, Chi –square test, t-test) ,
Unit 12: Multivariate Statistical techniques- Multiple regression,discriminate analysis,
Unit 13: Factor analysis, Multivariate analysis of variance,
Unit 14: Conjoint analysis, Cluster analysis, Multidimensional Scaling, Role of computer in research, Excel- A tool for statistical analysis, SPSS, Interpretation and conclusion.

Block V: Report Writing

Unit 15: Report Writing, Significance of report writing, Steps in report writing,
Unit 16: Layout of research report, Types of reports; Appendices;
Unit 17: Bibliography, Characteristics of a good report; Precautions for report writing
Unit 18: Ethics in business research.

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BUSINESS LAWS

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Block I: Contract Act, 1872

Unit 1: Definition & Classification of Contract, Essential elements of a Valid Contract,
Unit 2: Quasi Contract – Various Forms,
Unit 3: Contingent contract,
Unit 4: Discharge & Breach of Contract, Remedies of breach of contract.

Block II: Sales of Goods Act, 1930

Unit 5: Contract of sale of Goods-Meaning, Essentials, etc.
Unit 6: Provisions relating to Conditions and Warranties, Provisions relating to Transfer of Property **Unit 7:** Ownership, Provisions relating to Performance of Contract of Sale- Rights and duties of Unpaid Seller and Buyer.

Block III: The Negotiable Instruments Act, 1881

Unit 8: Negotiable Instruments- Meaning, Characteristics, Types, Parties- Holder and Holder in Due Course;
Unit 9: Negotiation and types of endorsements, Dishonour of Negotiable Instruments and Overdue Instrument,
Unit 10: Banker and Customer- Crossing of Cheques, Obligations of a Banker & a Customer, Bouncing of Cheques, Liabilities of parties.

Block IV: Partnership Act, 1932

Unit 11: Definition, Formation, Types and Registration of Partnership,
Unit 12: Kinds, Rights and liabilities of Partners, Minor's Status in Partnership Firm,
Unit 13: Dissolution of Partnership Firm.

Block V: The Companies Act, 1956 & 2013

Unit 14: Company- Definition, Meaning, Features and Types,
Unit 15: Incorporation of a Company- Memorandum & Articles of Association and their Alteration;
Unit 16: Prospectus, Management of company- Directors and Meetings,
Unit 17: Share capital-Account and Audit,
Unit 18: Winding up of companies.

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MASTER OF BUSINESS ADMINISTRATION

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HUMAN RESOURCE MANAGEMENT

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Block I: Introduction:

Unit 1: Conceptual foundations; Human aspect of management; Human resource Management- concept, scope and importance;
Unit 2: Competencies of HR manager- employer branding and competency mapping;
Unit 3: Changing role of HRM- workforce diversity, Technological change, restructuring and rightsizing, empowerment; TQM.
Unit 4: Management of ethics.

Block II: Human Resource Planning, Job Analysis, and Job Design:

Unit 5: Assessing human resource requirements; Human resource forecasting; **Unit 6:** Work load analysis; Job analysis; Job description and specifications; **Unit 7:** Job design; Job characteristic approach to job design.

Block III- Recruitment, Selection, Training, and Development:

Unit 8: Factors affecting recruitment; Sources of recruitment (internal and external);
Unit 9: Basic selection model; Psychological tests for selection; Interviewing; Placement and induction;
Unit 10: Job changes- Transfers, Promotions, and Separations;
Unit 11: An overview of training and development; Emerging trends in recruitment, selection, and development.

Block IV- Compensation Management, Performance Appraisal, and Audit:

Unit 12: Compensation Management- Job evaluation, base compensation and supplementary compensation;
Unit 13: Innovations in compensation management- Pay band system, ESOP; Performance appraisal- concept, traditional and modern methods-
Unit 14: MBO, 360degree appraisal, 720degree appraisal, behaviourally anchored rating scale, balanced scorecard; Potential appraisal.

Block V- Emerging Horizons of HRM

Unit 15: International HRM, challenges of international HR managers; Green HRM; E-HRM; HRIS (Human Resource Information System);
Unit 16: Human resource audit;
Unit 17: Contemporary issues in human resource management
Unit 18: Moonlighting phenomenon, employee engagement, flexi timing, psychological contract, managing protean career, layoffs.

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6111

INORGANIC CHEMISTRY- I

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Block I: Non-transition elements

Unit 1: Chemistry of Non-Transition Elements

Introduction to s-and p-block elements, General Trends in s-block elements, General Trends in p-block elements, Stereochemistry, Bonding

Unit 2: Quantitative Difference between Physical and Chemical Properties

Physical properties of s-and p-block elements, Chemical properties of s and p-block elements

Unit 3: Organometallic Compounds of Non-Transition Elements and their Importance

Introduction to Organometallic compounds, s-and p-block organometallic compounds and their synthesis and importance

Block II: s and p-Block elements: Group 1, 2, 13, 14 and 15

Unit 4: General Properties of p-Block Elements

Metal complexes and Clusters

Unit 5: Chemistry of Alkali and Alkaline Earth Metals

Alkali metals, Alkaline earth metals, General Characteristics of Alkaline earth metals

Unit 6: Chemistry of Group 13, 14, 15, And 16 Elements.

Boron Family and their compounds, Carbon Family and their compound, Nitrogen Family and their compounds, Oxygen Family and their compounds

Block III: Halogen Family

Unit 7: Chemistry of Halogen Compounds

Halogen Family, General properties of Halogens, Halogen Oxoacids, Applications

Unit 8: Polyhalogen and Interhalogen Compounds

Polyhalogen Compounds, Interhalogen Compounds and their Applications

Unit 9: Compounds of Halogens and Oxygen

Halogen Family, General properties of Halogens, Halogen Oxoacids, Applications

Block IV: Noble Gases

Unit 10: Chemistry of Noble Gasses

Chemistry of noble gases, Xenon compounds, Applications

Unit 11: Catenation between Heavier Elements

Occurrence, RE=ER (E = P, As, Sb, Bi), $R_2E=ER_2$ and R2E (E = Si, Ge, Sn, Pb) systems, Applications

Unit 12: Multiple Bonding between Heavier Elements

Nature of Bonding, Multiple bonding

Block IV: Phospha-Alkynes and Phospha-Alkenes, Chemistry of Alkali and Alkaline Earth Metals and Main Group Organometallic Chemistry

Unit 13: Phospha-Alkynes and Phospha-Alkenes.

Phospha-alkynes, Phospha-alkenes

Unit 14: Chemistry of Alkali and Alkaline Earth Metals

Chemistry of alkali and alkaline earth metals, their uses in homogeneous catalysis and material chemistry.

Unit 15: Main Group Organometallic Chemistry

Variable oxidation states of main group elements with special emphasis on recently developed Al(I) and Si(II)-silylene chemistry.

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6112

ORGANIC CHEMISTRY- I

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Block I: Stereoisomerism: Optical Isomerism

Unit 1: Chiral Molecules with One Stereogenic Centre

Stereoisomers, symmetry elements, chiral molecules with one stereogenic centre, optical activity, sequence rules, absolute configuration, enantiomeric excess.

Unit 2: Two (or More) Stereogenic Centres

Molecules with two (or more) stereogenic centres: diastereomers, Newman, Fischer and Sawhorse formulae.

Unit 3: Optical Isomerism

Erythro/threo, syn/anti configurations, meso configuration

Block II: Stereochemistry

Unit 4: Stereochemistry of Fused, Bridged, and Caged Ring Systems

Stereochemistry of fused, bridged, and caged ring systems

Unit 5: Resolution of Enantiomers

Resolution of enantiomers

Unit 6: Chirality Without Stereogenic Carbon

Chirality without stereogenic carbon: allenes, biphenyls, cyclophanes, helicenes, atropisomerism.

Block III: Steroisomerism in Cyclic Compounds

Unit 7: Steroisomerism in Cyclic Compounds

Steroisomerism in cyclic structures: cyclopropane, cyclobutene, cyclopentane.

Unit 8: Cyclohexane

Cyclohexane, decalins, anomeric effect, conformational analysis

Unit 9: Diasterotopic Groups and Faces

Prochirality, enantiotopic and diasterotopic groups and faces

Block IV: Reaction Intermediates

Unit 10: Carbocations, Carbanions and free radicals

carbocations, carbanions, Free radicals: Definition, Structure, Geometry, Stability, Reactivity and Applications.

Unit 11: Carbenes

Enolates, Carbenes, nitrenes, benzyne: Geometry, Stability, Reactivity and Applications.

Unit 12: Kinetic and Thermodynamic Control of Reactions

Kinetic and Thermodynamic control of reactions

Block V: Reaction Mechanism

Unit 13: Substitutions, Eliminations Reactions

Reaction mechanism: substitutions, eliminations reactions.

Unit 14: Additions, Rearrangements

Additions, rearrangements reactions

Unit 15: The Hammett Relationship

The Hammett relationship, stereochemistry and mechanism

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6113

PHYSICAL CHEMISTRY- I

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Block I: Introduction to Quantum Mechanism

Unit 1: Dawn of Quantum Mechanics

Introduction of Quantum Mechanics, Spectrum, black-body radiation, heat capacities, photoelectric and Compton effects

Unit 2: Atomic and Molecular Spectra

Atomic and molecular spectra, particle diffraction, wave-matter duality, Significance and Implications

Unit 3: Foundation of Quantum Theory

Foundation of Quantum Theory, Postulates of quantum mechanics, operators, role of operations in Quantum mechanism, specification and evolution of states

Block II: Schrodinger Wave Equation and its Applications

Unit 4: Schrodinger Wave Equation

Schrodinger wave equation, physical significance of wave functions and Properties of Eigen wave value

Unit 5: Translational Motion

Introduction of Translational Motion: Particle-in-a-box, penetration into and through barriers.

Unit 6: Harmonic Oscillator Rotational Motion

Introduction of Harmonic Oscillator Rotational Motion: Particle-on-a-ring, particle-on-a-sphere, motion in a coulombic field.

Block III: Hydrogen Atom

Unit 7: Hydrogenic Atoms and Angular Momentum

Hydrogenic Atoms and Angular Momentum

Unit 8: Many Electrons Atoms

Many Electron Atoms

Unit 9: Approximate Methods Perturbation theory

Approximate Methods and its challenges in quantum mechanics and purpose, Types of approximated methods, Perturbation theory and variational methods.

Block IV: Huckel Theory and its Molecular Orbital Wave Function

Unit 10: Huckel's Theory

Huckel's theory, resonance integral, energy level diagram, Resonance diagrams for ethene, cyclobutadiene, allyl system, butadiene, benzene.

Unit 11: Delocalization Energy of Organic Molecules

Delocalization energy of Organic Molecules: Ethene, cyclobutadiene, benzene, allyl cation, allyl radical, allyl anion, cyclopropyl anion, cyclopropyl radical and cyclopropyl cation

Unit 12: Huckel's Molecular Orbital Wave Function

Huckel's molecular orbital wave function electron density and bond order. Huckels molecular Orbitals for ethene, allyl cation, cyclobutadiene, benzene

Block V: Molecular Structure

Unit 13: Introduction to Molecular Structure

Introduction to Molecular Structure: Born-Oppenheimer approximation, molecular orbital theory.

Unit 14: Valence Bond Theory

Introduction and postulates of Valence bond theory, number of orbital and types hybridization, applications, limitations.

Unit 15: Computational Chemistry

Molecular modeling, drug designing, software used in molecular modeling, applications of Computer chemistry in drug.

MASTER OF SCIENCE (CHEMISTRY)

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ANALYTICAL CHEMISTRY- I

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Block I: General Introduction to Analytical Methods

Units 1: Measurement Basics and Data Analysis

Measurement basics and data analysis, Classification and selection of analytical methods, Types and Calibration of Instruments, Signals and Noise, Linear and Nonlinear regression analysis

Unit 2: Introduction to Spectrometric Methods

Introduction to Spectrometric Methods: General properties of electromagnetic radiation

Unit 3: Basic Elements of Spectroscopy

Basic elements of spectroscopy and its advantages, Einstein coefficients.

Block II: Spectroscopic Analysis

Unit 4: Atomic Absorption

Atomic Absorption Spectrometry: Sample atomization techniques, atomic Absorption instrumentation, Interferences in Atomic Absorption Spectroscopy, Atomic Absorption Analytical Techniques.

Unit 5: Emission Spectroscopy

Fluorescence Emission Spectroscopy: Atomic Fluorescence Spectroscopy, Emission Spectroscopy based on Plasma Sources, Emission Spectroscopy based on arc and Spark Sources.

Unit 6: Mass, And X-Ray Spectroscopy

Mass and X-Ray Spectroscopy: Introduction to Atomic Mass and X-Ray Spectrometry.

Block III: UV-VIS molecular absorption and Raman Spectroscopy

Unit 7: UV-VIS Molecular Absorption Spectrometry

UV-VIS Molecular Absorption Spectrometry: Measurement of Transmittance and Absorbance, Beer's Law, Effects of Instrumental Noise on Spectrophotometric Analyses, Instrumentation, Magnitude of Molar Absorptivity's, Absorbing Species.

Unit 8: Qualitative and Quantitative Analysis

Application of Absorption Measurement to Qualitative Analysis, Quantitative Analysis by Absorption Measurements, Photometric Titrations

Unit 9: Raman Spectroscopy

Raman Spectroscopy: Theory of Raman Spectroscopy, Instrumentation, Applications of Raman Spectroscopy, Types of Raman Spectroscopy.

Block IV: Infrared Spectrometry and Thermogravimetric Analysis

Unit 10: Infrared Absorption Spectrometry Structure

Theory of Infrared Absorption Spectrometry, Infrared Sources and Transducers, Infrared Instruments

Unit 11: Application of Infrared Spectroscopy

Application of Infrared spectroscopy, Photoacoustic Infrared Spectroscopy, Near-Infrared Spectroscopy

Unit 12: Thermogravimetric Analysis

Instrumentation, Thermogravimetric Curves, Sources of Errors in TGA, Factors Affecting TG Curve, Applications of Thermogravimetric Analysis

Block V: NMR and Mass Spectroscopy

Unit 13: Nuclear Magnetic Resonance Spectroscopy

Nuclear Magnetic Resonance Spectroscopy: Theory of Nuclear Magnetic Resonance (NMR), Environmental Effects on NMR Spectra, NMR Spectrometers, Applications of Proton NMR.

Unit 14: Carbon 13 NMR

Carbon13 NMR, Application of NMR to Other Nuclei, Two-Dimensional Fourier Transform NMR, Magnetic Resonance Imaging.

Unit 15: Mass Spectrometry

Mass Spectrometry: Molecular Mass Spectra, Ion Sources, Mass Spectrometers, Applications of Molecular Mass Spectrometry, Quantitative Applications of Mass Spectrometry.

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6115

PHOTOCHEMISTRY AND PERICYCLIC REACTIONS

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Block I: Photochemistry

Unit 1: Photochemical Processes and Excited States Properties

Absorption of light (radiation), Laws of photochemistry, Quantum yield or Quantum efficiency (Φ), Determination of Quantum yield (Efficiency of Quantum yield), Factors affecting quantum yield, Photosensitized Reaction, Photosynthesis, Photophysical Processes, Photochemical Processes, Jablonski Diagram, Potential Energy Surface, Potential Energy Curves (1-DPotentialEnergySurfaces), Mathematical definition and computation, Application of Potential Energy Surfaces, Properties of excited state, Dipole moment

Unit 2: Deactivation and Energy Transfer Mechanisms

Theories, factor effecting and application of Uni and Bimolecular deactivation, Quenching – types and factors affecting, applications, Electronic Energy Transfer Mechanisms and their factors

Unit 3: Photochemical Transformations

Intramolecular and Intermolecular photochemical processes- Isomerizations, rearrangements & dissociation, Factors impacting intermolecular additions in photochemical processes

Block II: Inorganic photochemistry

Unit 4: Fundamentals of Inorganic Photochemistry

Introduction to inorganic photochemistry, photochemical laws and photochemical kinetics, Laws of Absorption, Units of Molar Absorption Coefficient

Unit 5: Electronic Absorption in Inorganic Compounds

Photochemical processes. The electronic absorption spectra of inorganic compounds, Characteristics of the electronically excited states of inorganic compounds

Unit 6: Excited State Redox and Photosensitization

Photo electro chemistry of excited state redox reactions, Photosensitization

Block III: Photochemical reactions

Unit 7: Overview of Photochemical Reactions

Absorption of light (radiation), Laws of photochemistry: Quantum yield or Quantum efficiency (Φ), Determination of Quantum yield (Efficiency of Quantum yield), Factors affecting quantum yield, Photosensitized Reaction, Photosynthesis, Photophysical Processes, Photochemical Processes, Jablonski Diagram, Potential Energy Surface, Potential Energy Curves (1-DPotentialEnergySurfaces), Mathematical definition and computation, Application of Potential Energy Surfaces, Properties of excited state, Dipole moment

Unit 8: Miscellaneous Photochemical Reactions

Photo-Fries reactions of anilides, Photo Fries rearrangement, Barton reaction, Singlet molecular oxygen reactions, Photochemical formation of smog, Photo degradation of polymers, Photochemistry of vision.

Unit 9: Photochemistry in Biological Process

Photosynthesis, Photosystem I and Photosystem II, Excited States of Porphyrins and Metalloporphyrins, Porphyrins, Other Bioinorganic Systems

Block IV: Molecular orbital approach and pericyclic reactions

Unit 10: Symmetry and Molecular Orbitals

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system.

Unit 11: Molecular Orbital Theory

Woodward–Hoffmann: Conservation of Orbital Symmetry, Fukui: Frontier Molecular Orbital Theory Dewar–Zimmerman: Aromatic Transition State, Types of Diels–Alder Reactions, Net Bonding Interaction, Diastereoselectivity: Endo vs. Exo, Regioselectivity & Rates: Substituent Effects, Lewis Acid Effects

Unit 12: Electrocyclic Reactions and Molecular Motions

Electrocyclic Reactions- 4n, 4n+2 and Allyl Systems, Synthetic Applications of Electrocyclic Reactions

Block V: Cycloaddition reactions

Unit 13: Introduction of Cycloaddition Reactions

Cycloadditions - antarafacial and suprafacial additions, 4n and 4n+2 systems, 2 + 2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic reactions, Endo and Exo Stereochemistry.

Unit 14: Sigmatropic Rearrangements: H and C Shifts

Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5 - sigmatropic rearrangements.

Unit 15: Rearrangements and Reactive Dynamics

Claisen, Cope and aza-Cope rearrangements, Fluxional tautomerism, Ene reaction

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6151

CHEMISTRY LAB-I

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1. Qualitative Analysis of Inorganic Mixture

Identification of unknown radicals including insoluble residue by semi-micro analysis

2. Preparations of some Inorganic Complex Compounds

(i) Tetrammine Cupric Sulphate

(ii) Prussian Blue (Potassium Ferric Ferro cyanide)

(iii) Reineckes salt [Ammonium diammine tetra thio cyanato chromate (III)]

3. Preparations

(i) To perform Bromination: 2, 4, 6-tribromoaniline from aniline

(ii) To perform Oxidation: Benzil from benzoin by means of cupric salts

4. Separation of dyes using TLC method.

5. Perform pH-metric and potentiometric titration of phosphoric acid solution against standard NaOH solution. Compare the two results.

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MASTER OF SCIENCE
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CHM–6211

INORGANIC CHEMISTRY- II

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Block I: Coordination Chemistry: General Introduction

Unit 1: Introduction to Coordination Chemistry

Introduction of Coordination compounds, Structure, bonding and Isomers, Coordination Numbers and Structures.

Unit 2: Ligand Field Theory, Molecular Orbital Theory

Introduction to theories of Coordination compounds, Werner coordination theory, Crystal Field Theory, Ligand Field Theory, Angular Overlapping

Unit 3: Magnetic and Spectral Characteristics of Inner Transition Metal Complexes

Magnetic Susceptibility, Electronic Spectra, Coordination Number and Molecular Shapes/Geometry

Block II: Electron Transfer Reaction

Unit 4: Electron Transfer and Photochemical Reactions

Electron transfer and photochemical reactions of transition metal complexes, The Jahn-Teller Effect, Absorption of Light, Beer-Lambert Absorption Law.

Unit 5: Spectroscopic Properties of Transition Metal Complexes

Spectroscopic properties of transition metal, Magnetic Moments of Molecules and Ions, Colours of Transition Metal Complexes

Unit 6: Kinetics and Reaction Mechanism

Kinetics of the Reaction Mechanism, Rate Law for Dissociative Mechanisms, Rate Laws for Interchange Mechanisms, Rate Law for Associative Mechanisms

Block III: Metal-Metal Bonded Compounds and Bioinorganic Chemistry

Unit 7: Metal-Metal Bonded Compounds and Transition Metal Cluster Compounds.

Molecular orbital considerations in Dinuclear Metal Complexes with Multiple M-M Bonds, Cluster Compounds

Unit 8: Uses of Lanthanide Complexes

Lanthanide Complexes, Shift Reagents, Magnetic Compounds, Fluorescence

Unit 9: Bioinorganic Chemistry

Bioinorganic chemistry of iron, Haemoglobin, Myoglobin, Cytochromes, Bioinorganic chemistry of zinc, cobalt and copper

Block IV: Transition Elements

Unit 10: Introduction of Transition Elements

Electronic configuration, oxidation states, complex compounds, Configuration and Oxidation states, Coordination Chemistry of Lanthanides

Unit 11: Concepts of Molecular Symmetry

Symmetry Operations and Elements, Point Groups, Groups of Low and High Symmetry, Properties and Representations of Groups

Unit 12: Stereochemistry of Octahedral Reactions

Substitution in (trans-sys) octahedral complexes, Substitution in cis-en octahedral complexes Isomerization of Chelate Rings

Block V: Block II Struture/Isomers

Unit 13: Introduction to Structures and Isomers of Coordination Compounds

Nomenclature and Ligands, Isomerism, Stereoisomerism

Unit 14: Coordination Compounds of Transition Metals

Nomenclature of Complexes, Structure of Complexes, Isomerism in Complexes

Unit 15: Coordination Complexes in Nature and Technology

Transition Metal catalysis, Uptake and Storage of Transition Metals, Metalloproteins and Metalloenzymes

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ORGANIC CHEMISTRY- II

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Block I: Organic Synthesis

Unit 1: Formation of Carbon-Carbon Bonds and Applications

Organometallic reactions, Synthetic applications of organoboranes and organ silanes

Unit 2: Carbon-Hydrogen Bond Activation

C-H bond activation, Oxidations, Reductions, Newer Reagents, Design of organic synthesis

Unit 3: Retrosynthetic Analysis

Selectivity in organic synthesis, Protection and deprotection of functional groups, Multistep synthesis of some representative molecules

Block II: Synthetic equivalents

Unit 4: Strategy and Design of Organic Synthesis

Introduction, scope and brief history of organic synthesis, synthetic strategy, retro-synthesis, analysis and practice of total synthesis, linear and convergent synthesis

Unit 5: Concepts of Synthetic Equivalents and Umpolung

Synthetic equivalents and Umpolung benzoyl and acyl anion equivalents, dithianes, enol ethers and nitro compounds

Unit 6: Alkylation Reactions

Alkylation of enolates, enamines and hydra zones, alkylation of heteroatom stabilized anions.

Block III: Carbon-Carbon double bond formation

Unit 7: Carbon-Carbon Double Bond Formation

Carbon-Carbon double bond formation, Aldol condensation, Wittig and related reactions

Unit 8: Some Name Reactions

Peterson olefination, Julia-Lythgoe olefination, carbonyl coupling reaction (McMurry reaction)

Unit 9: Tebbe Reagent, Shapiro and Related Reactions

Tebbe reagent, Shapiro and related reactions

Block IV: Carbon-Carbon Triple Bond Formations and Cross Coupling Reaction

Unit 10: Elimination and Dehydration Reactions

Elimination reaction, Dehydration reaction, olefin metathesis and transition metal catalysed cross coupling reactions.

Unit 11: Carbon-Carbon Triple Bond Formations

Carbon-Carbon triple bond formations from acetylenes and from carbonyls

Unit 12: Triple Bond Formations from Olefins and Other Compounds

Olefins triple bonds, Cycloalkanes- strained rings, Eschenmoser fragmentation, allenes etc.

Block V: Ring Compounds

Unit 13: Three Membered Rings

Epoxides- using peracids, hydroperoxides and dioxiranes; transition metal catalysed epoxidation, halohydrins, Darzen's condensation, sulphur ylides, Cyclopropanes- Simmons Smith reaction, diazo compounds, sulphur ylides

Unit 14: Four Membered Rings

Various methods of forming cyclobutanes, cyclobutene's and oxetanes

Unit 15: Five Membered Rings

Intramolecular SN2 reactions, intramolecular Michael and aldol condensation reactions, intramolecular Wittig olefination, ring expansion and contraction reactions, 1,3-dipolar cycloaddition reactions.

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6213

PHYSICAL CHEMISTRY- II

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Block I: Introduction to Thermodynamics

Unit 1: Basics Concepts Thermodynamics

Basics concepts, Introduction of Laws of thermodynamics, Gibb's free energy, Chemical potential, Ideal and non-ideal solution

Unit 2: Phase Rule

Phase rule, Phase diagram, Solutions, Chemical equilibrium.

Unit 3: Postulates of Statistical Thermodynamics & Ensembles

Postulates of statistical thermodynamics, Ensembles, Monoatomic and polyatomic ideal gases, Molar heat capacities

Block II: Laws of Thermodynamics

Unit 4: Basic Concepts of State Function

Basic concepts (State function, mixed derivative, Equations of gases)

Unit 5: First Law of Thermodynamics

First law of thermodynamics (internal energy, enthalpy, heat capacity, Joule Thomson experiment)

Unit 6: Second and Third Law of Thermodynamics

Second and Third law of thermodynamics (entropy change, Clausius inequality, probability, absolute entropy)

Block III: Chemical Potential and Statistical Thermodynamics

Unit 7: Chemical Potential

History, Related terms, Thermodynamic chemical potential, Electronic chemical potential

The values of the chemical potential, Fundamental particle chemical potential, Clausius-Clapeyron Equation

Unit 8: Change of Chemical Potential

Definition, Effect of Change of chemical potential with reference to Temperature, pressure and addition of solute

Unit 9: Statistical Thermodynamics

Introduction of Statistical thermodynamics hemodynamic ensembles, mono and polyatomic ideal gases, molar heat capacities, Classical statistical mechanics

Block IV: Chemical and Phase Equilibrium

Unit 10: Ideal and Real Gases

Ideal and real gases, properties of fugacity, mixing and excess functions

Unit 11: Chemical Equilibrium

Chemical equilibrium, Conditions for Chemical Equilibrium, Equilibrium Constant, Reaching Chemical Equilibrium, Dynamic Equilibrium, Factors Affecting Chemical Equilibrium Le Chatelier's principle, partial molar quantities, standard states.

Unit 12: Phase Equilibrium

Phase equilibrium involving one, two and three components.

Block V: Equilibrium in Condensed Phases

Unit 13: Solutions

Types of solutions, concentration of solutions, solubility, colligative properties, binary solutions and azeotropes

Unit 14: Non-Ideal Systems

Non-ideal systems, activity and activity coefficients, Relationship between activity and activity Coefficients, Thermodynamic formulation of surface phenomena

Unit 15: Surface Chemistry

Adsorption, Distinction Between Adsorption And Absorption, Adsorption Mechanism, Types of Adsorption, Adsorption From Solution Phase, Catalysis, Homogeneous Catalysis, Heterogeneous Catalysis , Colloids, Emulsions.

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MASTER OF SCIENCE (CHEMISTRY)

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ANALYTICAL CHEMISTRY- II

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Block–1: Electron Microscopy and X-ray Crystallography

Unit 1: Scanning electron microscopy (SEM):

Introduction of Scanning electron microscopy (SEM), Basic principles, instrumentation and Sample Preparation, applications of SEM

Unit 2: Transmission electron microscopy (TEM)

Transmission electron microscopy (TEM): Introduction of Transmission electron microscopy (TEM), Basic Principles, Electron gun, Electromagnetic lenses, Imaging, Operating parameters- magnification, resolution, depth of field, Applications of TEM

Unit 3: Energy Dispersive X-ray Spectroscopy (EDS)

Energy Dispersive X-ray Spectroscopy (EDS): Introduction of EDS, Basic principles, instrumentation and Sample Preparation, interpretation and applications of EDS.

Block 2: Electroanalytical Techniques

Unit 4: Polarography

Polarography- Principles, Ilkovic Equation, factors affecting on polarographic wave, application.

Unit 5: Voltammetry

Voltammetry - Principle, cyclic Voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, application

Unit 6: Coulometry

Coulometry: Principles, types of Coulometric Methods; Controlled Potential Coulometry, Constant Current Coulometry; Applications of Coulometric Methods

Block 3: Thermal Analysis Techniques

Unit 7: Thermogravimetric Analysis

Thermogravimetric Analysis: Principle; Instrumentation: Working Function of Each Component; Sources of Error in TGA; Factors Affecting TG Curve; Interpretation of TG Curve Thermogravimetric analysis (TGA); Application of Thermogravimetric Analysis; Analysis of Inorganic Mixtures, Determination of nature of Gravimetric Precipitation, Reaction Kinetics

Unit 8: Differential Thermal Analysis

Differential Thermal Method of Analysis; Principle, Instrumentation, DTA Curves, Factors Affecting DTA Curves, Sources of Errors; Applications of DTA

Unit 9: Differential Scanning Calorimetry

Differential Scanning Calorimetry: Experimental Setup, Interpretation of DSC Curve, Applications of DSC, Advantages of DSC

Block 4: Chromatography Techniques

Unit 10: Thin layer chromatography (TLC)

Thin layer chromatography (TLC) - Fundamentals and Principles of Thin Layer Chromatography (TLC), Mobile- Stationary phases, Normal- Reverse phases, visualizing reagent ($KMnO_4$, Ninhydrin, DD and others), Applicability and Importance with examples

Unit 11: Gas Chromatography (GC)

Gas Chromatography (GC) -Fundamentals and Principles of Gas Chromatography (GC), Instrumentation, Sample preparation, Carrier gases , Injectors (split/splitless, PTV, Head Space, Pyrolyzer and others), Pack and Capillary Columns, Detectors (TCD, FID, ECD, NPD, TEA, Ion Mobility Scan), Applications and importance with examples, Limitations.

Unit 12: High Performance Liquid Chromatography (HPLC)

High Performance Liquid Chromatography (HPLC): Fundamentals and Principles of High Performance Liquid Chromatography (HPLC), Instrumentation, Types of HPLC–Normal phase HPLC, Reverse

Phase HPLC, Mobile phases, Sample preparation, Limitations of HPLC, HPLC injectors, HPLC pumps, HPLC columns, HPLC detectors (UV-Visible, fluorescence, PDA, RI and others).

Block 5: Analytical Biochemistry

Unit 13: Body Fluids Analysis

Body fluids analysis: Composition of body fluids and detection of abnormal level of certain constituents leading to diagnosis of diseases, Physiological and nutritional significances of water and fat soluble vitamins and minerals.

Unit 14: Immunological Methods

Immunological methods: General Processes of immune response, Antigen-antibody reactions, Precipitation reactions, radio, enzyme, and fluoro-immuno assays, affinity chromatography.

Unit 15: Analysis of Human Nutrition

Analysis of Human nutrition: Biological values and estimation of enzymes, carbohydrates, essential amino acids, proteins, and lipids.

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MASTER OF SCIENCE (CHEMISTRY)

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POLYMER CHEMISTRY

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Block I: Introduction to Polymers

Unit 1: Introduction and Classification of Polymers

Introduction and history of polymeric materials, Classification of Polymers-Thermoplastics and Thermosets, Classification based upon polymerization mechanism, classification based upon polymer structure.

Unit 2: Polymer Structure and Molecular Weight

Polymer structure (Copolymers, Tacticity, geometrical isomerism, nomenclature), Molecular weight (molecular-weight averages and molecular-weight distribution), chemical structure and thermal transitions.

Unit 3: Stereochemistry and Polymerization Methods

Stereoisomerism in polymers, Monosubstituted ethylenes (Site of steric isomerism, Tacticity), Stereoregular polymers: Significance of stereoregularity (isotactic, syndiotactic, and atactic polypropenes), Coordination polymerization: Ziegler Natta catalyst.

Block II: Polymer Synthesis

Unit 4: Step-Growth Polymerization: Synthesis and Kinetics

Synthesis and kinetics of step-growth polymerization, molecular weight in step-growth polymerization

Unit-5: Chain-Growth Polymerization: Mechanisms and Types

Chain-growth polymerization- free-radical polymerization and copolymerization, Ionic polymerization and copolymerization, coordination polymerization

Unit 6: Polymerization Techniques: Methods and Applications

Important techniques of polymerization such as bulk, solution, suspension, emulsion, melt polycondensation, solution polycondensation, interfacial-condensation, solid and gas phase polymerization.

Block III: Polymer-Structure Characterization

Unit 7: Determination of Polymer Molecular Weight

Determination of molecular weight of polymers (Mn, Mw, etc), by end group analysis, viscometry, light scattering, gel permeation chromatography and osmotic pressure methods

Unit 8: Molecular Weight Distribution in Polymers

Molecular weight distribution and its significance, Polydispersity index

Unit 9: Polymer Characterization Techniques

Polymer characterization by IR, NMR, X-ray etc

Block IV: Polymer Degradation And Stabilization

Unit 10: Types and Mechanisms of Polymer Degradation

Degradation in polymers, Types of degradation (chain-end and random), thermal degradation, mechanical degradation, degradation by ultrasonic waves, photodegradation, degradation by high-energy radiation, oxidative degradation,

Unit 11: Oxidation Processes in Polymers

Mechanism of rubber oxidation, ozone oxidation, oxidative degradation of saturated Polymers.

Unit 12: Polymer Stabilization Techniques

Polymer stabilization: antioxidants, photstabilisers.

Block V: Polymer Rheology

Unit 13: Fundamentals of Polymer Rheology

Introduction to polymer rheology: Newtonian and non-Newtonian flow, pseudo plastic, bingham, dilatants and thixotropic behaviour, Origin of non-Newtonian flow, Factors influencing flow behaviour:

molecular weight dependence, chain branching, temperature dependence and time dependence.

Unit 14: Rheometry and Flow Property Testing

Boundary conditions of rheometry, Standard test methods for melt flow rate, Measurement of flow properties, characteristics.

Uni -15: Thixotropy and Yield Stress Measurement

Measuring thixotropy: measuring the breakdown of thixotropic structures and measuring the rate of recovery of gel structure, measurement of yield stresses using CS and CR rheometers.

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MASTER OF SCIENCE (CHEMISTRY)

CHM–6251

CHEMISTRY LAB-II

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1. Inorganic analysis

(i) Estimation of chromium using certified standard materials colorimetrically.

(ii) Morphological analysis of metal oxides nano particles by Scanning Electron Microscopy.

2. Preparation of some inorganic Compounds

(i) Potassium tri oxalato ferrate (III) trihrdrate.

(ii) Sodium hexa nitrito cobaltate (III)

3. Organic Analysis

(i) Separation of organic compounds (phenol, catechol, resorcinol and pyrogallol) using TLC method

(ii) Paper chromatographic separation of Cu^{2+} and Cd^{2+}

4. Physical Analysis

(i) Determine the activity coefficient of Ag^{+} ions in $AgNO_3$ solution, potentiometrically, using a concentration cell with a salt bridge.

(ii) Study spectrophotometrically the kinetics of the reaction between potassium per sulphate and potassium iodide and determine the order and rate constant of the reaction.

(iii) A kinetic study of a solvolysis reaction-solvolysis of t-butyl CHMoride in acetone-water mixture.

5. Environmental Analysis

(i) Analysis of major anions (F, Cl, NO_3, SO_4) and major cations (Na, Ca, K, Mg, NH_4) in water by ion- exchange chromatography.

(ii) Determination of Cu/ Cd/Fe in water samples by Atomic Absorption Spectrophotometer.

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MASTER OF SCIENCE (PHYSICS)

PHM-6111

MATHEMATICAL PHYSICS-I

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Block-I: Theory of Functions of a Complex Variable

Unit-1: **Fundamentals of Complex Analysis-** Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula

Unit-2: Advanced Topics in Complex Analysis - Taylor's series and Laurent's series expansion, Zeros and singular points, Multi valuedfunctions, Branch Points and Cuts

Unit-3:Exploring Complex Analysis- Reimann Sheets and surfaces, Residues, Cauchy's Residue theorem, Jordan's Lemma

Unit-4:Complex Integration- Evaluation of definite integrals, Principal Value, Bromwich contour integrals.

Block-II: Fourier Transform

Unit-5: **Transforms-** Fourier transform, Sine, Cosine and Complex transforms with examples, Definition,Properties and Representations of Dirac Delta Function

Unit-6: **Analyzing Fourier Transforms-**Properties of Fourier Transforms, Transforms of derivatives

Unit-7:Exploring Fourier Transforms- Parseval's Theorem, Convolution Theorem, Momentum representation, Applications toPartial differential equations,

Unit-8: Discrete Fourier Transform -Discrete Fourier transform, Introduction to Fast Fourier transform

Block-III: Laplace Transforms

Unit-9: **Power of Laplace Transform-** Laplace transform,

Unit-10: **Laplace Transform-**Properties and examples of Laplace Transform

Unit-11: **Convolution Theorem-**Convolution theorem and its applications,

Unit-12: **Differential Equations with Laplace Transform Method-** Laplace transform method of solving differential equations.

Block-IV: Group Theory

Unit-13: **Fundamentals of Group Theory** Concept of a group (additive and multiplicative, isomorphism and homomorphism)

Unit-14: **Exploring Group Theory-** Matrix representation of a group, Reducible and irreducible representation of a group,

Unit-15: **Orthogonality Theorem** - The Great Orthogonality Theorem (without proof), Continuous,

Unit-16: **Lie Groups-** Lie groups.

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MASTER OF SCIENCE (PHYSICS)

PHM–6112

CLASSICAL MECHANICS

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Block I: Classical Mechanics Fundamentals and Principles

Unit 1: **Foundations of Classical Mechanics-** General idea of Newtonian physics; Mechanics of a particle, mechanics of a system ofparticles

Unit 2: **Exploring Classical Mechanics-** Constraints, generalized coordinates, D'Alembert's principle and Lagranges equations

Unit 3: Hamilton's Principle- Hamilton's principle, derivation of Lagrange's equations from Hamilton's principle,extension of Hamilton's principle to non-holonomic systems

Unit 4: Conservation Laws and Symmetry in Dynamics- Conservation theorems and symmetry properties, Generalized momenta, cyclic co-ordinates

Block II: Canonical Transformations and Hamilton-Jacobi Method

Unit 5: Canonical Transformations- Equation of canonical transformation, examples of canonical transformation

Unit 6: **Analyzing Poisson and Lagrange Brackets-** Poisson and Lagrange brackets and their invariance under canonical transformation, Jacobi'sIdentity, Poisson's Theorem

Unit 7: Infinitesimal Canonical Transformations- Equations of motion infinitesimal canonical transformation in the Poisson bracketformulation

Unit 8: Hamilton-Jacobi Method- Hamilton Jacobi Method, Generating functions.

Block III: Celestial Mechanics and Small Oscillations

Unit 9: Two-Body Central Force Problem- Two body central force problem: bound state, reduction of two-body problem to one body problem

Unit 10: Central Force Motion- Motion in a central force field, The virial theorem, the inverse square law of force

Unit 11: Central Force Motion- The motion in central force in the Kepler problem

Unit 12: Small Oscillations- Concept of small oscillations, eigen value equation, simple application (CO_2), Normalcoordinates and modes

Block IV: Tensor Analysis

Unit 13: **Elementary idea of tensors-** Elementary idea of tensors: co-variant, contra variant and mixed tensor, addition, subtraction, multiplication and characterization of tensors, quotient law.

Unit 14: Lorentz Transformations- Four-dimensional representation of the Lorentz transformations, covariance of the laws ofnature, four vectors; velocity momentum,

Unit 15: Force and Its Transformation- Force and their transformation, equation of motion of a point particle in four vector form,

Unit 16: Relativistic Dynamics in Electromagnetic Fields- Relativistic Lagrangian and Hamiltonian of a charged particle in an em field.

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MASTER OF SCIENCE
(PHYSICS)

PHM-6113

QUANTUM MECHANICS-I

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Block I: Introduction of Quantum Mechanics

Unit 1: **Mathematical Framework and Historical Context-** Mathematical tools and brief introduction to origins of quantum physics.

Unit 2: **Postulates and Vector Spaces-** Review of quantum postulates. Properties of linear vector space,

Unit 3: **Dirac Notation and Quantum Operator Theory-** Dirac notation. Operators, their Eigen values and Eigen functions, orthonormality, completeness and closure.

Unit 4:Unitary Operations and Basis Changes- Generalized Uncertainty Principle. Unitary transformations, change of basis.

Block II: Abstract Formulation

Unit 5: **Matrix Representation of Quantum Operators-** Matrix Representation of operators.

Unit 6: Continuous Basis in Quantum Mechanics- Continuous basis, position and momentum representation and their connection.

Unit 7: Unitary Transformations and Basis Changes -Change of basis and unitary transformation,

Unit 8: Expectation Values and Insights from the Ehrenfest Theorem- Expectation values and Ehrenfest theorem

Block III: Quantum Dynamics

Unit 9: **Schrödinger and Heisenberg Pictures Schrödinger and Heisenberg Pictures** Schrödinger picture, Heisenberg picture and equation of motion

Unit10: Harmonic Oscillator via Operator Methods- Classical limit, solution of harmonic oscillator by operator method

Unit11: Symmetries and Exploring Their Role And Significance- Symmetries in quantum mechanics, general view of symmetries,

Unit12: Spatial and Temporal Transformations- Spatial transition, continuous and discrete, time transition, parity and time reversal

Block IV: Angular Momentum

Unit 13: Properties and Commutation Relations- Angular Momentum, commutation relations of angular momentum

Unit 14: Orbital, Spin, and Total Operators- Orbital, Spin and total angular momentum operators.

Unit 15: **Pauli Spin Matrices-** Pauli spin matrices, their Commutation relations.

Unit 16: Eigenvalues, Eigenfunctions, and Clebsch-Gordan Coefficients- Eigen values and Eigen functions of L2 and Lz. Clebsch-Gordon coefficients

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MASTER OF SCIENCE (PHYSICS)

PHM-6114

CLASSICAL ELECTRODYNAMICS

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Block I: Review of Maxwell's Equation

Unit1: **Fundamentals of Electromagnetic Theory-** Review of Maxwell's equations, propagation of EM waves in conducting medium, linear, circular,elliptical polarization.

Unit 2: **EM Wave Behavior in Conducting Media-** Propagation of EM waves in conducting medium. Skin depth, Reflection and refraction frommetallic surface.

Unit 3: **Wave Propagation-** Propagation of waves between perfectly conducting planes, waves in hollow-conductors,

Unit 4: **TE and TM Modes-** TE and TM modes. Rectangular waveguides, resonant cavity

Block II: Particle Dynamics in EM field

Unit 5: **Relativistic Dynamics of Charged Particles-** Relativistic Charged particle motion in uniform statics E and B fields

Unit 6: **Interplay of Electric and Magnetic Fields-** Cross E & B fields

Unit 7: **Particle Drifts in Non-Uniform Static Magnetic Fields-** Particle drifts in (velocity and curvature) in non-uniform statics B field.

Unit 8: **Adiabatic Invariance and Magnetic Mirrors-** Adiabatic invariance and magnetic mirror.

Block III: Radiation

Unit 9: **The Lienard-Wiechert Potential-** Lienard Weichert potential, field produced by charged particle in motion,

Unit 10: **Radiation from Accelerated Charged Particles-** Radiation from accelerated charged particle, Larmor formula and its relativistic generalization,

Unit 11: **Scattering of Electromagnetic Radiation by Free Charges-** Scattering of EM radiation by free charges. Thomson scattering,

Unit 12: **Scattering by Charged Systems-** Scattering by a system of charges, dipole radiation.

Block IV: Lagrangian formulation of Electrodynamics:

Unit 13: **Lagrangian and Hamiltonian Formulations-** Lagrangian and Hamiltonian formulation for a free relativistic particle, for a charged particle inEM field

Unit 14: **Interaction of Charged Particles with Fields-** Interacting charged particle and fields

Unit 15: **Energy-Momentum Tensor and Conservation Laws-** Energy-momentum tensor and related conservation laws

Unit 16: **Canonical and Symmetric Stress Tensors-** Canonical and Symmetric Stress Tensors, Solution of the wave equation in covariant form

MASTER OF SCIENCE (PHYSICS)

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PHYSICS LAB-I (GENERAL LAB-I)

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List of Experiments

1. To determine the wavelength of the sodium light and the wavelength difference between D1and D2 lines using Michelson interferometer.
2. To measure the thickness of thin wire using He-Ne laser.
3. To measure wavelength of He-Ne laser using diffraction grating.
4. To determine Hall coefficient and mobility of charge carriers in a given sample ofsemiconductor.
5. To measure wavelengths of the Balmer lines of hydrogen spectrum and to determine theRydberg constant for hydrogen atom from the measurement of these lines.
6. To determine the wavelength of sodium light and D1 and D2 lines by Febry-Perotinterferometer.
7. To Study of losses in optical fiber.
   (a) Measurement of propagation loss.
   (b) Measurement of bending loss.
8. To measure Numerical Aperture of Optical Fibre.
9. Demonstrate the Faraday-Effect using Flint Glass.
10. To determine the e/m ratio using Zeeman Effect.

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MASTER OF SCIENCE (PHYSICS)

PHM–6211

STATISTICAL MECHANICS

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Block I: Classical ensemble theory

Unit 1: **Quantum Statistical Mechanics of Identical Particles-** Quantum statistical mechanics of identical particles, Condition for statistical equilibrium,

Unit 2: **Symmetry, Probability, and Quantum Ensembles-** Symmetry of wave function, Postulate of equal a prior probability, Random walk, Ensemblein quantum statistics,

Unit 3: **Grand Canonical Ensemble & Quantum Distributions-** Grand Canonical Ensemble, Partition function, Quantum distribution functions (Bose-Einstein and Fermi-Dirac),

Unit 4: **Derivation via Grand Partition Function-** Derivation of distribution laws using grand partition function.

Block II: Quantum ensemble theory

Unit 5: **Phase Space, Liouville's Theorem, and Microcanonical Gas Theory-** Phase space and Liouville's theorem, Micro canonical ensemble theory and its application toideal gas of monatomic particles

Unit 6: **Canonical Ensemble: Thermodynamics and Ideal Gas Dynamics-** Canonical ensemble and its thermodynamics, partition function, classical ideal gas incanonical ensemble theory, energy fluctuations,

Unit 7: **Gibbs Paradox, Sackur-Tetrode Equation, and Quantum Ensembles-** Gibbs paradox and its solution, Sackur-Tetrode equation, a system of quantum harmonic oscillators as canonical ensemble, Grand canonical ensemble,

Unit 8: **Statistical Quantities and Ideal Gas in Grand Canonical Ensemble-** Significance of statistical quantities, classical ideal gas in grand canonical ensemble theory.

Block III: Ideal Bose systems

Unit 9: **Ideal Bose Gas and Bose-Einstein Condensation: Fundamentals and Thermodynamics-** Basic concepts and thermodynamic behaviour of an ideal Bose gas, Bose-Einstein condensation,

Unit10: **Blackbody Radiation and Ideal Fermi Systems: Thermodynamic Behavior-** Blackbody radiation-Planck's formula, Ideal Fermi systems: thermodynamic behavior of an idealFermi gas,

Unit 11: **Heat Capacity of Free-Electron Gas at Low Temperatures: Insights and Discussion-** Discussion of heat capacity of a free-electron gas at low temperatures,

Unit 12: **Electron Gas in Metals: Exploring the H-Theorem-** Electron gas in metals, H-theorem.

Block IV: Phase transition

Unit 13: **Phase Transitions: Ising Model and Critical Fluctuations-** Phase transitions, Ising model, Thermodynamic fluctuations, Critical exponents,

Unit 14: **Thermodynamic Limit and Random Walk Dynamics-** Thermodynamic limit and its importance Random walk

Unit 15: **Brownian Motion, Diffusion, and Fluctuation-Dissipation-** Brownian motion, Diffusion equation, Fluctuation-Dissipation theorem.

Unit 16: **Universality in Phase Transitions: Ising vs. Heisenberg Models-** Concepts of universality of phase transitions, Ising and Heisenberg models

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QUANTUM MECHANICS-II

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Block I: Approximation methods for stationary systems

Unit 1: **Perturbation Theory: Non-Degenerate States-** Time independent perturbation theory. Perturbation of non-degenerate states: first and secondorder perturbation.

Unit 2: **Perturbation: Harmonic Oscillator & Degeneracy Removal-** Perturbation of a harmonic oscillator. Perturbation of degenerate states, removal of degeneracy.

Unit 3: **Zeeman, Isotopic, and Stark Effects-** Zeeman effect, isotopic shift and Stark effects.

Unit 4: **Variational & WKB Methods-** Variational and WKB methods.

Block II: Approximation methods for time dependent problems

Unit 5: **Interaction Picture & Time-Dependent Perturbations-** Interaction picture and Time dependent perturbation theory

Unit 6: **Dynamics: Constant & Harmonic Perturbations-** Equations of Motion. Constant and harmonic perturbation.

Unit 7: **Transition Probabilities: Discrete and Continuous Cases-** Discrete and continuous case, transition probability. Fermi golden rule.

Unit 8: **Adiabatic and sudden-** Adiabatic and sudden approximations.

Block III: Scattering Theory

Unit 9: **Scattering of Wave Packets: Theory-** Scattering Theory Scattering of a wave packet.

Unit 10: **Cross Sections and Born Approximation** -The differential and total Cross section. The Born approximation.

Unit 11: **Partial Waves, Lippman-Schwinger Equation, S-Matrix Properties-** Partial waves and phase shifts, The Lippman Schwinger equation.

Unit 12: **S-Matrix & T-Matrix: Properties and Optical Theorem** -Definition and properties of S-matrix, T matrix. Optical theorem.

Block IV: Relativistic Quantum Mechanics

Unit 13: **Klein-Gordon & Dirac Equations: Properties of Matrices-** Klein-Gordon and Dirac equations, properties of Dirac matrices.

Unit 14: **Dirac Equation: Plane Wave Solution & Electron Spin-** Plane wave solution of Dirac equation. Spin and magnetic moment of the electron

Unit 15: **Non-Relativistic Dirac Equation: Central Forces & Hydrogen Atom** -Non-relativistic reduction of the Dirac equation. Central forces and the hydrogen atom.

Unit 16: **Hydrogen Atom in Dirac Theory & Dirac Electron in Magnetic Field-** Hydrogen atom in Dirac's theory, Dirac electron in constant magneticfield,

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MASTER OF SCIENCE (PHYSICS)

PHM–6213

NUCLEAR AND PARTICLE PHYSICS

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Block I: General properties of atomic nuclei

Unit 1: **Atomic Nuclei: Properties & Nuclear Forces**- General properties of atomic nuclei and nuclear forces (qualitative),binding energy,

Unit 2: **Nuclear Potentials & Deuteron States**- Types of nuclear potential, Ground and excited states of deuteron,

Unit 3: **Tensor Force & Spin Dependence in Nuclear Force**- Tensor force S & D states, spin dependence ofnuclear force,

Unit 4: **Low-Energy n-p and p-p Scattering** -n-p scattering and p-p scattering at low energies.

Block II: Review of barrier penetration of alpha decay

Unit 5: **Alpha Decay Barrier Penetration & Geiger-Nuttal Law: Review**- Review of barrier penetration of alpha decay &Geiger-Nuttal law.

Unit 6: **Beta Decays: Fermi Theory & Transition Types**- Beta decays, Fermi theory, Allowed and forbiddentransitions,

Unit 7: **Parity Violation in Beta Decay & Electron Capture**- Experimental evidence for Parity-violation in beta decay, Idea of electron capture,

Unit 8: **Gamma Transition Multipolarity & Selection Rules**- Multipolarity of gamma transitions and selection rules, internal conversion, idea ofCoulomb excitation.

Block III: Nuclear models

Unit 9: **Extreme Particle Model: Square-Well & Harmonic Oscillator**- Extreme particle model with square-well & harmonic oscillator potentials

Unit 10: **Spin-Orbit Coupling & Shell Model Predictions**- Spin-orbit coupling, shell model predictions, magnetic moment-Schmidt lines,

Unit 11: **Single-Particle Model: Total Spin Configurations** - Single particle model, Total spin 'J' for various configurations,

Unit 12: **Electric Quadrupole Moment & Nuclear Collective Modes**- Electric quadrupole moment. Collective modes of motion, nuclear vibrations androtations.

Block IV: Introduction of elementary particles

Unit 13: **Elementary Particles: Quantum Numbers & Conservation Laws**- Introduction of elementary particles. Quantum numbers and conservation laws,

Unit 14: **Charge Conjugation, Time Reversal, CPT Theorem & Particle Families** -Charge conjugation, time reversal invariance, CPT theorem. The Baryon decuplet,meson octet, quark spin and color.

Unit 15: **Pion-Parity, Neutrino Helicity, K-Decay & CP Violation** - Pion-Parity, Neutrino Helicity, K-Decay & CP Violation- Pion-parity, helicity of neutrino, K-decay, CP violation in K-decay and itsexperimental determination, resonances,

Unit 16: **Hadron Classification: SU(2) and SU(3) Symmetry**- Special symmetry groups SU(2) and SU(3) classification of hadrons, quarks, Gell-Mann-Okubo mass formula.

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MASTER OF SCIENCE (PHYSICS)

PHM–6214

COMPUTATIONAL PHYSICS AND PROGRAMMING

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Block I: Algorithmic Process, Basics of 'C' Programming

Unit 1: Foundations of Programming: Algorithms, Analysis, and Languages- Algorithms, General Approaches & Analysis, Program and Programming Language, Fundamental Stages of Problem Solving, Feature of Programming Language, Flow Charts.

Unit 2: Mastering C: Learning Outcomes and Programming Essentials- Learning outcomes, Program and Programming Language, Introduction to C Language, Programming Format of C, Creating a C Program, Compilation process in C Program, Link and Running C Program, Diagrammatic Illustration.

Unit 3: C's Core Elements: Characters, Tokens, Keywords, and Identifiers -Building Blocks – Character set of C, C Tokens, Keywords and Identifiers of the C.

Unit 4: Essential 'C' Elements: Data Types and Variables- Fundamental elements of 'C' – Data Types in C, Variables.

Block II: Operator and Expressions of 'C', Control Flow Mechanisms

Unit 5: Coding Logic: Operators, Expressions, and Conversions in C- Logical and Relational – Operators in 'C', Expressions in 'C' and Types Conversions in Expressions.

Unit 6: Essential Concepts in C: Control and Loop Statements- Key Terminologies, Design Control Statements, Loop Control Statements and ExitFunction.

Unit 7: Data Management in C: Arrays and Function Handling- Declaring & Accessing Data Elements, Arrays Declaration, Initialization and Passing Functions.

Block III: Strings, Tools for Modular Programming and Pointers

Unit 8: Essential Skills in C: Strings Overview and Usage- Essential Techniques & Functions, Declaration and Initialization of Strings,Overview and Applications.

Unit 9: Function Essentials: Prototypes, Calls, Returns, Storage, and Recursion- Functions Prototypes, Calling a Function, Return Statement, Sets of Variables & Storage Classes and Recursion.

Unit 10: Mastering Pointers: Variables, Functions, and Strings -Handle Variables and Parameters, Pointer and their Characteristics, Passing Pointersto Functions and Pointers and Strings.

Block IV: Multiple Data Elements, Preprocessors Directives and Files

Unit 11: Structures in Action: Declaration, Access, Initialization, and Pointers- Declaration of Structures, Accessing the Members of a Structure, Initializing, Function Arguments and Pointers to Structures.

Unit 12: Unions Unveiled: Definition, Initialization, and Access - Defining of Unions, Initialization of Unions and Accessing the Members of an Union.

Unit 13: C Preprocessing and Translation: Constants, File Handling, and Conditional Compilation- Translation Phase, 'C' Preprocessor, Implement Constants, Reading from other filesand Conditional Selection of code and Pre-Processor Commands.

Unit 14: File Handling Mastery in C: Pointers, Input/Output, and Access Modes- File Handling in C using file Pointers, Input and Output using file Pointers, Sequential Vs Random Access Files and Unbuffered I/O – The UNIX File Routines.

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MASTER OF SCIENCE
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PHYSICS LAB-II
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List of Experiments

1. To study of 8085 and 8086 Microprocessor training kit.
2. To perform addition of two 8 bit numbers; sum 8 and 16bit.
3. To perform addition and subtraction of two 8 bit numbers; sum16 bit.
4. To perform the decimal addition of two8 bit number, sum 16-bit.
5. To find the largest number from a given number of string.
6. To perform multiplication of 8 bit data; product should be 16bit.
7. To move a block of data from one memory location to another memory location.
8. To write an assembly language program to shift 8 bit no.(left shift).
9. To interface 8255 P Pi to microprocessor and set port A as input port inMode0.
10. To interface ADC card to microprocessor& generate the digital output.
11. To interface DAC card to microprocessor& generate a square wave on CRO.
12. To study the plateau characteristics of a G-M counter
13. To determine the range of beta-rays
14. To study the energy dependence of the absorption coefficient of aluminum for gamma-rays.

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MASTER OF SCIENCE

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PHM–6252

COMPUTATIONAL PHYSICS AND PROGRAMMING LAB

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Programming Lab

- Introduction (Overview of the Lab)
- Objectives
- Overall Directions
- Algorithms and Flow Charts
- Structure of 'C' Program
- Salient Features of C
- 'C' Program development Environment
    - Phase-I: Creating a Program
    - Phase-II&III: Preprocessing and Compiling a 'C' Program
    - Install Visual Studio Code on Windows
- How to design/develop Program
- Structure of 'C' Program
- Compile and Run 'C' Program
- Practice Sessions (Session 1 to Session 5)

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