# REVISED SYLLABI FOR
# CSS COMPETITIVE EXAMINATION, CE-2016
# FPSC, F-5/1, AGA KHAN ROAD, ISLAMABAD
## Updated on: 7th July, 2015

**To select subject(s) of 200 marks only**

**Subjects:-**

1. **Physics** **(200 Marks)**
2. **Chemistry** **(200 Marks)**
3. **Applied Mathematics** **(100 Marks)**
4. **Pure Mathematics** **(100 Marks)**
5. **Statistics** **(100 Marks)**
6. **Geology** **(100 Marks)**

# PHYSICS (200 Marks)

## Paper-I (MARKS-100)

### I. Mechanics

- Vectors
  - Dots
  - Cross and triple products
  - Gradient
  - Divergence
  - Curl and applications
- Newtonian laws of motion
  - Calculus based approach to kinematics
  - Forces and dynamics
  - Conservation law of energy
  - Conservation of linear and angular momentum
  - Dynamics of rigid body
  - Cpin and precession
  - Cyroscope
  - Gravitation
  - Planetary motion and satellites
  - Kepler's laws
  - Centripetal forces
- Special theory of relativity
  - Michelson-Morley experiment and Einstein's postulates
  - Lorentz transformation
  - Time dilation and length contraction

- Equivalence of mass and energy

## II. Fluid Mechanics

- Surface tension
- Viscosity
- Elasticity
- Fluid motion and Bernoulli's theorem

## III. Waves and Oscillations, Optics

- Free oscillation with one and two degrees of freedom
  - Forced and damped oscillations and phenomenon of resonance
  - Simple harmonic motion
  - Traveling waves and transmission of energy
  - Phase and Group velocity
  - Standing waves; Basics of sound waves
- Reflection
- Refraction
- Interference
- Diffraction and Polarization of waves

- Interfero meter and Newton's rings
- Diffraction Gratings and their resolving power
- Spectro meters
- Electromagnetic wave equation
- Normal and anamolous dispersion
- Coherence
- Lasers and applications

## IV. Heat and Thermodynamics

- Perfect gas
- real gas and Van der Waals equation
- Three Laws of Thermodynamics
    - Internal energy
    - Temperature
    - Entropy
- Thermal properties of simple systems
    - Kinetic theory of gases
    - Maxwellian distribution of molecular velocities
    - Brownian motion
    - Transport phenomena

- Classical Maxwell-Boltzmann Statistics and its application
- Bose-Einstein and Fermi-Dirac Statistics.

## Paper-II (MARKS-100)

### I. Electricity and Magnetism

- Electric field due to point charges
- Gauss' law
- Electric potential
- Poisson and Laplace's equations
- Dielectric medium and Polarization
- Capacitance
- Moving charges and resulting magnetic field
- Ampere's law
- Magnetic properties of matter
- Faraday's law of electromagnetic induction
- Alternating current and RLC circuit
- Poynting theorem and Poynting Vector.
- Maxwell's equations in integral and differential form

- Scalar and vector potential

## II. Modern and Quantum Physics

- Waves And Particles And De Broglie's Hypothesis
- Operators And Quantum States
- Observables
- Time Dependent And Independent Schrodinger Equation
- Angular Momentum
- Spin-1/2 Particle In A Magnetic Field
- Wave Mechanics; Particle In A Box
- Tunneling
- One-Dimensional Harmonic Oscillator
- Heisenber's Uncertainty Relationship And Indeterminacy Based On Commutation Properties Of Operators
- Bohr's Theory And Quantum Numbers Including Electron Spin
- Pauli's Exclusion Principle
- Spectra Of Simple Systems With One Or Two Valence Electrons
- Photo Electric Effect

- Compton Scattering
- Pair Production
- Lande's G Factor And Zeeman Effect
- Raman Effect

## III. Solid State Physics

- Crystal Lattice And Structure
- Bravais Lattice
- Free Electron Model
- Band Theory And Electron In A Periodic Potential
- Fermi Energy And Density Of State
- N And P Type Semiconductors
- Physics Of The Transistor And Mosfet
- Dielectric Properties
- Magnetic Properties And Origin Of Magnetism

## IV. Nuclear Physics

- Structure Of Nuclei
- Radioactivity a, b And g Decay
- Methods Of Detection Of Nuclear Radiation

- Mass Sepectrometer
- Accelerators
- Phenomenon Of Fission
- Reactor And Nuclear Power
- Nuclear Fusion And Its Applications
- Elementary Particles And Their Properties

## SUGGESTED READINGS



1 Perspectives of Modern Physics. **BY** A. Beiser

2 Fundamentals of Physics. **BY** Halliday & Resnick

3 Introduction to Electromagnetic Fields and Waves. **BY** D. Corson & P. Lorrain

4 Heat and Thermodynamics. **BY** D. Zemansky

5 Introduction to Quantum Mechanics **BY** D. Griffiths

6 Modern Physics **BY** Serway, Moses, Moyer

7. Solid State Physics **BY** C. Kittel

# CHEMISTRY (200 Marks)

## Paper-I (MARKS-100)

### I. Atomic Structure and Quantum Chemistry

- Electromagnetic Spectrum
- Photoelectric Effect
- Bohr's Atomic Model
- Wave And Particle Nature Of Light Matter
- De Broglie's Equation
- Heisenberg's Uncertainty Principle
- Wave Functions And Born Interpretation Of Wave Functions
- Probability Density
- Eigen Functions And Eigen Values
- Hamiltonian Operator
- Schrödinger Wave Equation And Its Solution For Particle In One And Three Dimensional Box



### II. Electrochemistry

- Ions In Solution
- Measurement Of Conductance And Kohlrausch's Law
- Mobility Of Ions And Transport Number
- Conductometric Titrations
- Debye-Hückel Theory And Activity Coefficient
- Determination Of Activities
- Redox Reactions
- Spontaneous Reactions
- Electrochemical Cells
- Standard Electrode Potentials
- Liquid Junction Potential

- Electrochemical Series
- Nernst's Equation
- Measurement Of Ph
- Electrolytic Cells
- Potentiometry
- Reference And Indicator Electrodes
- Fuel Cells
- Corrosion And Its Prevention

**III. Thermodynamics**

- Equation Of States
- Ideal And Real Gases
- The Van Der Waals Equation For Real Gases
- Critical Phenomena And Critical Constants
- Four Laws Of Thermodynamics And Their Applications
- Thermochemistry
- Calorimetry
- Heat Capacities And Their Dependence On Temperature
- Pressure And Volume
- Reversible And Non-Reversible Processes
- Spontaneous And Non-Spontaneous Processes
- Hess's Law
- The Born-Haber Cycle
- Relations Of Entropy And Gibbs Free Energy With Equilibrium Constant
- Gibbs Helmholtz Equation
- Fugacity And Activity

**IV. Chemical Kinetics**

- The Rate And Molecularity Of Reactions
- Factors Affecting Rate Of A Chemical Reaction

    - Zero, First, Second And Third Order Reactions With Same Initial Concentrations
- Halflives Of Reactions
- Experimental Techniques For Determination Of Order Of Reaction
    - Integration
    - Half-Life
    - Initial Rate
    - Graphical Methods
- Collision Theory
- Transition State Theory
- Arrhenius Equation And Rate Equations Of Complex Reactions

**V. Surface Chemistry And Catalysis**

- Properties Of Liquids
- Physical And Chemical Properties Of Surface
- Determination Of Surface Area
- Adsorption And Absorption
- Physical Adsorption And Chemisorption
    - Adsorption Isotherms
    - Langmuir Adsorption Isotherm
    - Freundlich Adsorption Isotherm
- Colloids
    - Properties
    - Classification
    - Preparation Of Colloidal Systems
- Surfactants
- Phase Rule
    - Gibbs Equation Of Phase Rule
- One Component Systems
    - Examples

- Two Component Systems
    - Examples
- Catalysis
    - Homogeneous Catalysis
    - Heterogeneous Catalysis
    - Acid-Base  Catalysis
    - Enzyme Catalysis

**VI. Fundamentals Of Chemometrics**

- Sampling
- Significant Figures
- Stoichiometric Calculations
- Measurement Errors
- Analysis Of Variance (Anova)
- Arithmetic Mean
- Median
- Mode
- Standard Deviation/Relative Standard Deviation
- Confidence Limits
- Gaussian Distribution
- Least Square Method
- Statistical Tests

**VII. Separation Methods**

- Solvent Extraction
    - Theory Of Solvent Extraction
    - Solvent Extraction Of Metals
    - Analytical Separations
    - Multiple Batch Extraction
    - Counter Current Distribution
- Chromatography

    - Theory Of Chromatography
    - Classification And Overview Of Chromatographic Techniques (Paper, Thin Layer, Column And Ion Exchange Chromatographies)
- Principle Of Electrophoresis
    - Its Application As Separation And Characterization Of Proteins.

**VIII. Basic Inorganic Chemistry**

- Types Of Chemical Bonding
- Ionic And Covalent Bonding
- Localized Bond Approach
- Theories Of Chemical Bonding
- Valance Bond Theory (Vbt)
- Hybridization And Resonance
- Prediction Of Molecular Shapes Using Valence-Shell Electron-Pair Repulsion (Vsepr) Model
- Molecular Orbital Theory (Mot) Applied To Diatomic Molecules
- Delocalized Approach To Bonding
- Bonding In Electron Deficient Compounds
- Hydrogen Bonding
- Physical And Chemical Properties Of P-Block Elements With Emphasis On Oxygen
- Carbon
- Chlorine
- Silicon
- Nitrogen
- Phosphorus
- Some Of Their Representative Compounds

**IX. Acids And Bases**

- Brief Concepts Of Chemical Equilibrium
- Acid–Base Theories Including Soft And Hard Acid And Base (Shab) Concept
- Relative Strength Of Acids And Bases
- Significance Of Ph, Pka, Pkb And Buffer Solutions
- Theory Of Indicators
- Solubility
- Solubility Product
- Common Ion Effect
- Their Industrial Applications

X. Chemistry Of D And F-Block Elements

- General Characteristics Of D-Block Elements
- Historical Background Of Coordination Chemistry
- Nomenclature And Structure Of Coordination Complexes With Coordination Number 2-10
- Chelates And Chelate Effect
- Theories Of Coordination Complexes
    - Werner's Theory
    - Valence Bond Theory (Vbt)
    - Crystal Field Theory (Cft)
    - Molecular Orbital Theory (Mot)
- Jahn-Teller Theorem
    - Magnetic Properties
    - Spectral Properties
    - Isomerism
    - Stereochemistry
    - Stability Constants Of Coordination Complexes
- General Characteristics Of Lanthanides

- Occurrence
- Extraction And General Principles Of Separation
- Electronic Structure And Position In The Periodic Table
- Lanthanide Contraction
- Oxidation States
- Spectral
    - Magnetic Properties
    - Uses
- General Characteristics Of Actinides
    - Electronic Structure
    - Oxidation State And Position In The Periodic Table
    - Half-Life
    - Decay Law

## Paper-II (MARKS-100)

**I. Basic Concepts of Organic Chemistry**

- Bonding and orbital hybridization
- Localized and delocalized bonding
- Inductive effect
- Dipole moment
- Resonance
- Hyperconjugation.

**II. Saturated and Unsaturated Hydrocarbon**

- Nomenclature
- Physical properties
- Preparation and reactions of alkanes
- alkenes and alkynes

**III. Chemistry of Aromatic Compounds**

- Benzene structure
- Aromaticity
- Mechanism of electrophilic substitution reaction
- Activating and deactivating substituents
- Effect of substituents on orientation and reactivity

**IV. Chemistry of Functional Groups**

- Preparation and properties of alcohols
    - Phenols
    - Ethers
    - Amines with focus on reaction mechanism and applications
- Preparation and reactions of alkyl halides
- Synthetic applications of Grignard reagent
- Carbonyl compounds
- Preparations and reaction mechanism of aldehydes and ketones and their applications
- Carboxylic acids and their derivatives
- Acidity of carboxylic acids and effect of substituents on their acidity
- Preparation and reactions of carboxylic acids and their derivatives including acid halides
- Acid anhydrides
- Esters
- Amides

**V. Aliphatic nucleophilic substitution and elimination reactions**

- Mechanism of nucleophilic substitution reactions
- Elimination reactions

- Zaitsev rule and Hofmann rule
- Competition between Substitution and elimination reactions

**VI. Stereochemistry**

- Molecular chirality
- Types of stereoisomers R,S configuration and E,Z designation
- Optical activity
- Stereoselectivity and stereospecificity
- Resolution of racemic mixtures

**VII. Organic Spectroscopy**

- Theory
- Principle
- Instrumentation
- Applications of UV/Visible
- 1 H NMR
- IR spectroscopy
- Mass spectroscopic techniques



**VIII. Biomolecules**

- Carbohydrates
- Monosaccharides
- Oligosaccharides and polysaccharides
- Biological functions of starch
- Glycogen
- Cellulose
- Cell wall polysaccharides
- Lipids
    - Classification and biological importance of lipids
    - Significance of lipids in biological membranes and transport mechanism

- Amino Acids
    - Classification of amino acids.
    - Physical and chemical properties of amino acids
    - Biological significance
- Proteins
    - Classification
    - Properties and biological significance
    - Primary, secondary tertiary and quaternary structures
- Nucleic Acids
    - Chemical composition of nucleic acids
    - Structure and biological significance of nucleic acids
- Enzymes
    - Enzyme-substrate interactions and nature of active site,
    - mechanism of enzyme action
- Kinetics of single substrate reactions
- Enzyme inhibition
- Regulatory enzymes
- Allosteric enzymes



**IX. Metabolism**

- Digestion
- Absorption and transport of proteins
- Carbohydrates
- Lipids and nucleic acids
- Glycolysis
- Citric acid cycle
- Gluconeogenesis
- Glycogenesis
- Glycogenolysis and photosynthesis
- Biosynthesis of triglycerides
- Phosphides

- Steroids and bile acids and ketone bodies
- Biochemical reaction of amino acids
- Decarboxylation
- Deamination
- Transamination and Transmethylation
- Urea cycle, creatine and uric acid synthesis
- Catabolism of nucleosides
- DNA polymerases
- Other enzymes involved in metabolism

**X. Chemical Industries**

- Manufacturing and processing of sugar
- Cement
- Glass
- Paper
- Fertilizers
- Soap
- Detergents



## SUGGESTED READINGS

1. Physical Chemistry, 4th ed., 2005 **BY** Silbey, R. J., Alberty, R. A., and Bawendi, M. G.
2. Physical Chemistry – A Molecular Approach, 1st ed. 1997 **BY** McQuarrie, D. A. and Simon, J. D.
3. Atkin's Physical Chemistry, 9th ed. 2010 **BY** Atkins, P. and Paula, J. D.
4. Physical Chemistry, 4th ed. 1972 **BY** Moore. W. J.
5. Modern Analytical Chemistry, 2000 **BY** Harvey, D.
6. Quantitative Chemical Analysis, 8th ed. 2011 **BY** Harris, D.C.,
7. Analytical Chemistry. 6th ed., 2006 **BY** Christian, G. D.

8. CHEMOMETRICS-Statistics and Computed applications in Analytical Chemistry, 2nd ed., 2007 **BY** Matthios, O.
9. Statistics and Chemometrics for Analytical Chemistry, 5th ed. 2005 **BY** Miller, J. and Miller, J
10. Separation Chemistry 2004 **BY** Budhiraja, R.P
11. Advanced Inorganic Chemistry, 6th ed. 2007 **BY** Cotton, F.A. and Wilkinson, G.
12. Inorganic Chemistry, 4th ed. 2010 **BY** Miessler, G. L. and Tarr, D.A.
13. Inorganic Chemistry, 5th ed. 2010 **BY** Shriver, D. and Atkins, P.
14. Textbook of Inorganic Chemistry 2013 **BY** Chaudhary, S. U.
15. Organic Chemistry, 10th ed. 2011 **BY** Solomons, T. W. G., and Fryhle, C. B.
16. Organic Chemistry, 6th ed. 2012 **BY** Brown, W. H., Fotte, C. S., Iverson,B.L. and Anslyn, E. V.
17. Organic Chemistry, 8th ed. 2012 **BY** John, E. M.
18. Introduction to Spectroscopy, 4th ed., 2009 **BY** Pavia, D. L.,Lampman, G. M., Kriz,G.S. and Vyvyan, J. R.,
19. Spectrometric Identification of Organic Compounds 2005 **BY** Silverstein, R. M. Webster, F. X. and Kiemle, D.
20. Organic Spectroscopy 2006 **BY** Younas, M.
21. Stereochemistry (Basic Concepts in Chemistry) 2002 **BY** Morris, D. G. 22. Shreve's Chemical Process Industries, 5th ed. 1984 **BY** Shreve, R. N. and Austin, G. T.
23. Riegel's Handbook of Industrial Chemistry 2003 **BY** Riegel, E. R., and Kent, J. A.

# APPLIED MATHEMATICS (100 Marks)

## I. Vector Calculus (10%)

- Vector Algebra
- Scalar And Vector Products Of Vectors
- Gradient Divergence And Curl Of A Vector
- Line
- Surface And Volume Integrals
- Green's, Stokes' And Gauss Theorems.

## II. Statics (10%)

- Composition And Resolution Of Forces
- Parallel Forces And Couples
- Equilibrium Of A System Of Coplanar Forces
- Centre Of Mass Of A System Of Particles And Rigid Bodies
- Equilibrium Of Forces In Three Dimensions

## III. Dynamics (10%)

- Motion In A Straight Line With Constant And Variable Acceleration
- Simple Harmonic Motion
- Conservative Forces And Principles Of Energy
- Tangential Normal, Radial And Transverse Components Of Velocity And Acceleration
- Motion Under Central Forces
- Planetary Orbits
- Kepler Laws

**IV. Ordinary Differential Equations (20%)**

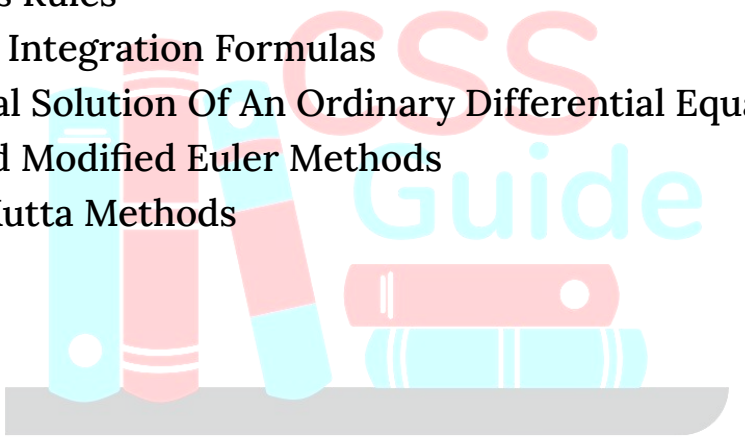
- Equations Of First Order
- Separable Equations
- Exact Equations
- First Order Linear Equations
- Orthogonal Trajectories
- Nonlinear Equations Reducible To Linear Equations
- Bernoulli And Riccati Equations
- Equations With Constant Coefficients
- Homogeneous And Inhomogeneous Equations
- Cauchy-Euler Equations; Variation Of Parameters
- Ordinary And Singular Points Of A Differential Equation
- Solution In Series
- Bessel And Legendre Equations
    - Properties Of The Bessel Functions And Legendre Polynomials

**V. Fourier series and partial differential equations (20%)**

- Trigonometric Fourier Series
- Sine And Cosine Series
- Bessel Inequality
- Summation Of Infinite Series
- Convergence Of The Fourier Series
- Partial Differential Equations Of First Order
    - Classification Of Partial Differential Equations Of Second Order;
- Boundary Value Problems
- Solution By The Method Of Separation Of Variables
- Problems Associated With Laplace Equation
- Wave Equation
- The Heat Equation In Cartesian Coordinates

**VI. Numerical Methods (30%)**

- Solution Of Nonlinear Equations By Bisection
- Secant And Newton-Raphson Methods
- The Fixed- Point Iterative Method
- Order Of Convergence Of A Method.
- Solution Of A System Of Linear Equations
- Diagonally Dominant Systems
- The Jacobi And Gauss-Seidel Methods
- Numerical Differentiation And Integration
- Trapezoidal Rule
- Simpson's Rules
- Gaussian Integration Formulas
- Numerical Solution Of An Ordinary Differential Equation
- Euler And Modified Euler Methods
- Runge- Kutta Methods






## SUGGESTED READINGS

1. An Introduction to Vector Analysis **BY** Khalid Latif,
2. Introduction to Mechanics **BY** Q.K. Ghori
3. An Intermediate Course in Theoretical Mechanics **BY** Khalid Latif,
4. Differential Equations with Boundary Value Problems **BY** D. G. Zill and M. R. Cullen
5. Elementary Differential Equations **BY** E.D. Rainville, P.E. Bedient and R.E. Bedient
6. Introduction to Ordinary Differential Equations **BY** A.L.Rabenstein
7. Advanced Engineering Mathematics **BY** E. Kreyszig
8. An Introduction to Numerical Analysis **BY** Mohammad Iqbal

9. Numerical Analysis **BY** R.L Burden and J.D Faires
10. Elements of Numerical Analysis **BY** F. Ahmad and M.A Rana
11. Mathematical Methods **BY** S. M. Yousaf, Abdul Majeed and Muhammad Amin

# PURE MATHEMATICS (100 Marks)

## Section-A (40- marks)

### I. Modern Algebra

- Group
- Subgroups
- Lagrange's Theorem
- Cyclic Groups
- Normal Subgroups
- Quotient Groups
- Fundamental Theorem Of Homomorphism
- Isomorphism Theorems Of Groups
- Inner Automorphisms
- Conjugate Elements
- Conjugate Subgroups
- Commutator Subgroups
- Ring
- Subrings
- Integral Domains
- Quotient Fields
- Isomorphism Theorems
- Field Extension And Finite Fields
- Vector Spaces
- Linear Independence
- Bases
- Dimension Of A Finitely Generated Space
- Linear Transformations
- Matrices And Their Algebra
- Reduction Of Matrices To Their Echelon Form
- Rank And Nullity Of A Linear Transformation

- Solution Of A System Of Homogeneous And Non-Homogeneous Linear Equations
- Properties Of Determinants

## Section-B (40- marks)

II. Calculus & Analytic Geometry

- Real Numbers. Limits
- Continuity
- Differentiability
- Indefinite Integration
- Mean Value Theorems
- Taylor's Theorem
- Indeterminate Forms
- Asymptotes
- Curve Tracing
- Definite Integrals
- Functions Of Several Variables
- Partial Derivatives
- Maxima And Minima
- Jacobnians
- Double And Triple Integration (Techniques Only)
- Applications Of Beta And Gamma Functions
- Areas And Volumes
- Riemann-Stieltje's Integral
- Improper Integrals And Their Conditions Of Existences
- Implicit Function Theorem
- Conic Sections In Cartesian Coordinates

- Plane Polar Coordinates And Their Use To Represent The Straight Line And Conic Sections
- Cartesian And Spherical Polar Coordinates In Three Dimensions.
- The Plane
- The Sphere
- The Ellipsoid
- The Paraboloid And The Hyperboloid In Cartesian
- Spherical Polar Coordinates

## Section-C (20-marks)

III. Complex Variables

- Function Of A Complex Variable
- Demoiver's Theorem And Its Applications
- Analytic Functions
- Cauchy's Theorem
- Cauchy's Integral Formula
- Taylor's And Laurent's Series
- Singularities
- Cauchy Residue Theorem
- Contour Integration
- Fourier Series And Fourier Transforms

## SUGGESTED READINGS


1. Advanced Calculus **BY** Kaplan, W.

2. Analytic Function Theory **BY** Vol.1 Hille, E.

3. Calculus Anton **BY** H.,Biven I and Davis, S.

4. Complex Analysis **BY** Goodstein G.R.G.

5. Complex Variables **BY** Murray R. Spiegel

6. Calculus with Analytic Geometry **BY** Yusuf, S.M.

7. Calculus and Analytic Geometry **BY** Zia ul Haq

8. Elements of Complex Analysis **BY** Pennisi, L.L.

9. Theory of Groups **BY** Majeed, A.

10. Mathematical Methods **BY** Yusuf, S.M.

11. Mathematical Techniques **BY** Karamat H.Dar

12. Mathematical Analysis **BY** Apostal, T.M.

13. The Theory of Groups **BY** Macdonald, I.N.

14. Topics in Algebra **BY** Herstein, I.N.

# STATISTICS (100 Marks)

## Part-1 (50- marks)

### I. Descriptive Statistics

- Definition, Importance and scope of Statistics, Descriptive and Inferential Statistics, Presentation of the Data, Tables, Graphs and Charts: Stem-and leaf diagram, Box and Whisker Plots. Measures of Central Tendency/location, Measures of Dispersion/Variability: Measures of Skewness and Kurtosis.

### II. Basic Probability

- Basic Probability Concepts, Additive and Multiplicative laws of Probability, Joint and Marginal Probabilities, Conditional Probability and Statistical Independence, Bayes' rule. Concept of a Random Variable, Mathematical Expectations, Discrete and Continuous Random Variables, Probability Distribution, Mean and Variance of a Discrete Probability Distribution.

### III. Probability Distributions

- Discrete and continuous Probability Distributions. Properties, applications of Binomial, Poisson, Hyper-geometric distribution, Normal Distribution and its properties, Standard Normal Curve, Normal approximation to Binomial and Poisson distribution.

### IV. Regression Analysis & Correlation Analysis

- Concepts of Regression and Correlation and their application, Simple and Multiple Linear Regression (upto three variables), Estimation of the Parameters of simple regression Model, Method of least square, Inference regarding regression parameters. Correlation, Correlation Coefficient, Properties of Correlation

Coefficient, Inference regarding correlation coefficient, Partial Correlation and Multiple Correlation Coefficients (upto three variables).

**V. Non-Parametric Methods**

- Parametric versus nonparametric tests, when to use non-parametric procedures, One-sample tests: Sign test, Wilcoxan signed ranks tests, Kolmogrov-Smirnov test, run test. Tests for two related samples: sign test, run tests, chi-square test, Test for two independent samples: Mann-Whitney test, Kolmogrov-Smirnov test.



## Part-1 (50- marks)

**I. Sampling & Sampling Distributions**

- Population and Sample, Advantages of Sampling, Sampling Design, Probability & Non-Probability Sampling techniques. Brief Concepts of Simple Random, Stratified, Systematic, Cluster, Multiphase and Multistage Sampling. Non-probability sampling: Purposive, Quota Sampling, Convenience & Accidental Sampling. Sampling with and without replacement, Application of Central Limit Theorem in Sampling, Sampling Distribution of Mean, difference between two Means, Proportion, difference between two Proportion and Variance.

**II. Statistical Inferences**

- Estimation: Point Estimation, Properties of a good Estimator. Interval Estimation. Interval Estimation of Single Population means and Single proportion. Difference between two means and Difference between two proportions. Hypothesis Testing: Types of errors. Hypothesis Testing for Population Mean. Inferences for difference between Two Population Means. Inferences for the difference between Means of Two Normal Populations using Independent Samples (variances are assumed Equal) for sample size. Inference for Two Populations Mean using Paired Samples.Hypothesis testing for Single Population Proportion and difference between two population proportions. Estimation of sample size Analysis of categorized data. Goodness of fit tests. Contingency tables. Test of independence in contingency tables.

**III. Design of Experiments**

- One-way and Two-way Analysis of Variance, Design of Experiments, Concepts of Treatment, Replication, Blocking, Experimental Units and Experimental Error, Basic Principles of Design of Experiments, Description, Layout and Statistical Analysis of Completely Randomized Design (CRD), Randomized Complete Block Design (RCBD), Multiple Comparison tests (LSD test).

**IV. Population Analysis & Vital Statistics**

- Population and Demographic Methods, Sources of Demographic data, Basic Demographic Measures, Sex Ratio, Child Women Ratio, Vital Index, Crude and Specific Birth and Death Rates, Total Fertility and Net Reproduction Rates. Official Statistics: Statistical Systems in Pakistan, Functions of Statistics Division, Bureaus of

Statistics and NADRA. The National Income, Gross Domestic Product, Saving and Wealth, Index Numbers

## SUGGESTED READINGS


1. Principles and Procedures of Statistics **BY** Steel, R and Torrie, J.H.

2. Probability and Statistics for Engineers and Scientist **BY** Walpole, R.E., Myers, R.H. and Myers, S.L.

3. Introduction to Statistical Theory, Part-I & II **BY** Chaudhry, S.M. and Kamal, S.

4. Introduction to Probability Theory and Statistical Inference, 3rd Edition. **BY** Larson, H.J.

5. Design and Analysis of Experiments **BY** Montgomery, D.C.

6. Fundamentals of Modern Statistical Methods **BY** Wilcox, R.

7. Biostatistical Analysis **BY** Zar, J.H.

8. Latest Statistical Methods **BY** Vaidyanathan, M.

9. Statistical Methods **BY** Aggarwal, Y.P.

10. Mathematical Statistics **BY** Freund, John E.

11. Demographic Methods **BY** Andrew Hinde

12. Publications of Federal Board of Statistics and Provincial Board of Statistics, Pakistan. **BY** Govt. of Pakistan

# GEOLOGY (100 Marks)

## Part-1 (50- marks)

### I. Introduction to Physical Geology

- Introduction And Scope Of Geology
- Its Importance And Relationship With Other Sciences
- Earth As A Member Of The Solar System
    - Its Origin
    - Age
    - Composition And Internal Structure
- Introduction To Rocks And Minerals
- Weathering And Erosion
- Isostasy
- Geological Time Scale



### II. Stratigraphy and Paleontology

- Principles Of Stratigraphy
- Laws Of Superposition And Faunal Succession
- Geological Time Scale With Divisions
- Classification And Nomenclature Of Stratigraphic Units
    - Lithostratigraphic Units
    - Biostratigraphic Units
    - Chronostratigraphic Units
- Introduction To Fossils And Their Significance
- Modes Of Fossilization
- Study Of Morphology
- Range And Broad Classification Of Major Invertebrate Phyla

- Introduction To Micro Fossils
- Introduction To Paleobotany
- Introduction And Classification Of Major Vertebrates
- Introduction To Micropaleontology

**III. Mineralogy**

- Classification Of Minerals
- Study Of Internal Structure
- Polymorphism And Isomorphism
- Paragenesis
- Physical And Optical Properties Of The Common Silicate And Non-Silicate Mineral Groups
- Introduction To Crystallography
    - Elements Of Symmetry
    - Study
    - Normal Classes Of Crystallographic Systems



**IV. Structural Geology and Tectonics**

- Stress-Strain Concepts
- Factors Controlling The Mechanical Behavior Of Materials
- Folds
- Faults
- Joints
- Foliation
- Terminology
- Classification And Relationship With Bedding
- Lineation
- Unconformity

- Plate Tectonics Theory
- Geological Evidences For Continental Drift
- Sea-Floor Spreading
- Oceanic Ridges
- Continental Rifts
- Intra-Oceanic Islands
- Hot Spot And Mantle Plumes
- Wilson Cycle
- Tectonic Framework Of Pakistan

**V. Petrology and Petrography**

- Introduction
- Classification And Description Of Sedimentary Rocks
- Origin
- Transportation And Deposition Of Sediments
- Texture Of Sedimentary Rocks
- Sedimentary Structures
    - Their Classification
- Morphology And Significance
- Composition
- Origin
- Differentiation And Evolution Of Magma
- Classification Of Igneous Rocks
- Mode Of Occurrences And Types Of Extrusive Rocks
- Texture And Structure Of Igneous Rocks
- Introduction To Metamorphism
    - Types Of Metamorphism
    - Grades
    - Zones And Facies Of Metamorphism

    - Metamorphic Diffusion And Differentiation
    - Metamorphism In Relation To Plate Tectonics
- Differentiation Between Metamorphism And Metasomatism
- Introduction To Polarizing Microscope
- Optical Properties Of Opaque And Non-Opaque Minerals In Plane Polarized Light And Under Crossed Nicol Including Metallic Under Reflected Light
- Description Of Optical Properties Of Common Rock Forming Minerals

## Part-2 (50- marks)

### I. Introduction to Geophysics

- Definition And Relation Of Geophysics With Other Sciences
- Classification And Brief Description Of Various Branches Of Geophysics Such As Seismology
- Geomagnetism
- Geoelectricity
- Tectonophysics
- Gravimetry
- Geo-Thermy And Geodesy
- Introduction To Various Geophysical Techniques For Exploration Of Mineral Deposits
- Oil And Gas
- Subsurface Water And Engineering Works

## II. Sequence Stratigraphy

- Introduction
    - History
    - Concept And Significance Of Sequence Stratigraphy
    - Data Sources
    - Seismic Reflections
    - Outcrops
    - Well Logs
    - Core And Seismic Facies
- Sea Level Changes
    - Their Causes And Effects
- Accommodation
- Eustatic And Relative Sea Curve
- Hierarchy Of Sequence Stratigraphic Elements
- Types Of Sequences And Systems Tracts

## III. Petroleum Geology

- The Nature And Classification Of Petroleum Hydrocarbons
- Their Origin
- Migration And Accumulation
- Source Sediments
- Reservoir Rocks And Trapping Mechanism For Oil And Gas
- Prospecting And Exploration Of Oil And Gas
- Reservoir
    - Characteristics
    - Drive Mechanism
    - Energy And Pressure Maintenance
    - Secondary And Enhanced Recovery
- Introduction To Sedimentary Basins Of Pakistan

**IV. Engineering and Environmental Geology**

- Rock And Soil Mechanics And Its Application In Civil Engineering
- Rock Mass Characteristics
- Geotechnical Studies Of Rocks And Soils
- Geological Factors And Strength Of Rocks
- Study Of Geological Factors In Relation To The Construction Of Buildings' Foundations
    - Roads
    - Highways
    - Tunnels
    - Dams
    - Bridges
- Application Of Geophysical Methods For Site Investigation
- Construction Materials
- Mass Movement
    - Their Causes And Prevention
- Introduction To Environmental Geology
- Management Of Natural Resources
- Global Climatic Changes
- Environmental Controls For Erosion
- Desertification And Coastal Degradation
- Geological Hazards Such As Floods Landslides, Earthquakes, Tsunamis, Volcanoes, Glaciers And Shoreline Processes
- Remedial Measure
- Clean Sources Of Energy
- Industrial Pollution
- Solid And Liquid Waste Disposal
- Introduction To Environmental Impact Assessment
- Initial Environmental Examination

**V. Mineral and Energy Resources**

- Introduction Of Geological Exploration/Prospecting
- Brief Description Of Hydrocarbons
    - Coal
    - Gemstones
    - Copper
    - Lead
    - Zinc
    - Iron
    - Gold
    - Chromite
    - Manganese
    - Salt
    - Gypsum
    - Bauxite
    - Sulphur
    - Barite
    - Fluorite
    - Clays
    - Phosphorite
- Building And Dimension Stones
- Industrial Rocks And Minerals
- Radioactive Minerals And Rocks
- Special Reference To Economic Mineral Deposits In Pakistan
    - Origin
    - Occurrence
- Depositional Environments Of Coal

- Coal Constitution And Its Kinds
    - Coal Rank
    - Grade And Calorific Value
    - Coal Deposits Of Pakistan With Reference To Thar Coal
- Geothermal Energy Resources Of Pakistan.

**VI. Economic and Applied Geology**

- Metallic And Non-Metallic Mineral Resources Of Pakistan
- Mineral-Based Industries
- Overview Of Recodec Copper
- Radioactive Minerals And Their Occurrences In Pakistan
- Gemstones Of Pakistan
- Geology Of Reservoirs
    - Dams
    - Highways And Tunnels
- Major Natural Hazards And Their Impacts On The Environment With Special Reference To Pakistan



## SUGGESTED READINGS

1. Physical Geology **BY** Charles Plummer, David McGeary, Diane Carlson,

2. Physical Geology **BY** Charles (Carlos) Plummer, Diane Carlson

3. Principles of Physical Geology **BY** Holmes, A

4. Principles of Paleontology **BY** Raup, D.M. & Stanley, S.M

5. Vertebrate Paleontology **BY** Romer, A.S

6. Invertebrate Paleontology and Evolution **BY** Clakson, E.N.K

7. Stratigraphy of Pakistan **BY** Shah, S.M.I.

8. Principles of Sedimentology and Stratigraphy **BY** Boggs, S

9. Stratigraphy and Historical Geology of Pakistan **BY** Kazmi, A.H and Abbasi, I.A

10. Igneous and Metamorphic Petrology **BY** Best, M.G.,

11. Introduction to Optical Mineralogy **BY** Nesse, W.D

12. An Atlas of Minerals in Thin Section **BY** Schulze, D.J.,

13. Minerals and Rocks **BY** Klein, C.,

14. Mineral Characterisation and Processing **BY** Mohapatra, B.K., Misra, V 15. Principles of Mineralogy **BY** William. H.B.,

16. Mineralogy **BY** Perkins, D

17. Plate Tectonics – Geodynamics **BY** Moores, E.M. & Twiss, R.J

18. Structural Geology of Rocks and Regions **BY** George H. Davis, Stephen J. Reynolds, Charles F. Kluth

19. Structural Geology **BY** Twiss, R.J. & Moores, E.M.,

20. Carbonate Sedimentology **BY** Tucker, M.E. & Wright, V.P

21. Applied Sedimentology **BY** Selly, R.C.,

22. Petrology of Sedimentary Rocks **BY** Boggs Jr. S

23. Sedimentary Rocks **BY** Pettijohn, F.J

24. Introduction to Applied Geophysics Burger R.H., **BY** Sheehan, A. & Jones, C

25. Geophysical Methods in Geology **BY** Sharma, P.V

26. The Solid Earth: An Introduction to Global Geophysics **BY** Fowler, CMR 27. Igneous and Metamorphic Petrology **BY** Best, M.G

28. Petrology: Igneous, Sedimentary, & Metamorphic **BY** Blatt, H., Tracy, R.& Owens, D

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30. Metamorphic Petrology **BY** Turner, F.J.,

31. Sequence Stratigraphy **BY** Emery, D. & Myers, K.J.,

32. Elements of Petroleum Geology **BY** Richard C. Selley,

33. Petroleum Geology North, **BY** F.K.,

34. Geology of Pakistan **BY** Bender, F.K. & Raza, H.A.,

35. Engineering Geology: Principles and Practice **BY** David George Price, Michael de Freitas



36. Engineering Geology **BY** F G Bell

37. Fundamentals of Engineering Geology **BY** Bell, F.A.G.,

38. Environmental Geology **BY** Montgomery, C.W.,

39. Geology of Himalaya, Karakuram, Hindukush in Pakistan **BY** Tahirkheli, R.A.K.,

40. Geology of Pakistan **BY** Bender, F.K. & Raza,

41. Stratigraphy and Historical Geology of Pakistan **BY** Kazmi, A.H and Abbasi, I.A

42. Economic Geology: Principles and Practice **BY** Walter L. Pohl

43. Directory of Mineral Deposits of Pakistan **BY** Zaki, A.,

44. An Introduction to Ore Geology **BY** Evans, A.M.,

45. Metallogeny and Mineral Deposits of Pakistan **BY** Kazmi, A.H. & Abbas, S.G.,

46. Introduction to Mineral Exploration **BY** Moon, C.J., Whateley, M.K.G. and Evans, A.M.

47. Energy Resources **BY** Brown and Skipsy

48. Pakistan Energy Yearbook 2012 **BY** Ministry of Petroleum and Natural Resources Hydrocarbon Development Institute of Pakistan. Islamabad

Subject Wise Notes will be provided here soon through CSS-Guide APP by ZH Softs