# RBI Officer Grade-B Exam Pattern / Syllabus 2024

**Reserve Bank of India Services Board, Mumbai**
**Advt. No. 2A /2024-25**

**Appendix-II**

**SCHEME OF SELECTION AND SYLLABUS FOR OFFICERS IN GR 'B' (DR) - GENERAL- PY 2024**

Selection will be through ONLINE examinations and Interview. Examinations will be held in two phases, as described in the following paragraphs:

(I) **Phase-I Online Examination (Objective Type)**

This will comprise a single Paper for 200 marks and will be held on September 08, 2024**.**  Depending on the number of candidates, the examination may be held in multiple shifts and on some other days also.  A candidate, however, must appear for examination in only one shift on the given day. The date, time and venue on which a candidate has to appear for examination will be specified in the Admit Card to be downloaded by the candidate from Bank's website ([www.rbi.org.in](www.rbi.org.in)). The 'corrected-scores' obtained by each of the candidates in different sessions (if held) will be normalized using equipercentile method. (If the examination is held in more than one session, the scores across various sessions will be equated following IBPS' standard practice to adjust for slight differences in difficulty level of different test batteries used across sessions.)

a)   The Paper will consist tests of :
   i.   General Awareness
   ii.   English Language
   iii.   Quantitative Aptitude and
   iv.   Reasoning

A total time of 120 minutes will be given for answering. However, separate time will be allotted for each test. Other detailed information regarding the examination will be given in an Information Handout, which will be made available to the candidates for download along with the Admit Card for examination from the RBI website.

Candidates have to secure minimum marks separately for each test as well as in aggregate, as may be prescribed by the Board.

Candidates, who secure minimum marks separately for each Test, as prescribed, will be shortlisted for Phase-II of the examination based on the aggregate marks obtained in Phase-I.  The minimum aggregate cut-off marks for being shortlisted for Phase-II of the examination will be decided by the Board in relation to the number of vacancies.  Roll Number of the candidates shortlisted for Phase-II examination will be published on the RBI website, tentatively within a week after Phase-I examination.

(ii) **Phase-II Online Examination**

The Phase-II Online Examination will be conducted **on October 19, 2024** only for the candidates who are shortlisted on the basis of results of Phase-I and based on the cut-off decided by the Board. The Phase-II examination will be in shifts. Candidates are required to appear for all the shifts. Separate Admit Cards will be issued for each shift. The timetable for Phase-II will be intimated to the candidates concerned along with Admit Card for Phase-II. Phase–II online examination will consist of three papers as under:

| Name of Paper | Type of Paper | Time (Minutes) | Number of questions | Marks |
|---|---|---|---|---|
| **Paper-I:** Economic and Social Issues | 50% Objective Type | 30 Minutes | @ | 50 |
| | 50% Descriptive Type, answers to be typed with the help of the keyboard. Candidates opting to type the answers in Hindi, may type with the help of either: (i) | 90 Minutes | | 50 |

| | | | | |
|---|---|---|---|---|
| | Inscript or (ii) Remington (GAIL) keyboards layout. | | | |
| | Total | 120 Minutes | | 100 |
| **Paper-II:** English (Writing Skills) | Descriptive, to be typed with the help of the keyboard | 90 Minutes | 3 | 100 |
| **Paper-III:** General Finance and Management | 50% Objective Type | 30 Minutes | @ | 50 |
| | 50% Descriptive Type, answers to be typed with the help of the keyboard. Candidates opting to type the answers in Hindi, may type with the help of either: (i) Inscript or (ii) Remington (GAIL) keyboards layout. | 90 Minutes | | 50 |
| | Total | 120 Minutes | | 100 |

**@For both Paper-I and Paper-III, there will be 30 questions and 50 marks for Objective questions (some questions carrying 2 marks each and some carrying 1 mark each). In case of Descriptive questions, 6 questions will be asked, of which candidates will be required to attempt 4 questions [2 of 15 marks each (with varying difficulty level) and 2 of 10 marks each]. In case, candidate answers more than 4 questions in descriptive, first 4 shall be evaluated.**

**NOTE**:All question papers (in both the Phases, except the test of English) will be set bilingually in Hindi and English.

The Board reserves the right to modify the examination dates and time entirely at its discretion.

(iii) **Interview**

Candidates will be shortlisted for the Interview, based on aggregate of marks obtained in Phase-II (Paper-I +Paper-II +Paper-III). The minimum aggregate cut-off marks for being shortlisted for Interview will be decided by the Board in relation to the number of vacancies. Roll Numbers of the candidates shortlisted for the Interview will be published on RBI website at appropriate time and Interview Call Letters will be sent on registered E-mail ID. Interview will be of 75 marks.

Candidate shall be required to undergo Personality Assessment conducted by the Bank before appearing for the Interview. No marks will be allotted for the same and it will not form part of the final selection criteria. Candidate may opt for Interview either in Hindi or English. Final selection will be through merit list which will be prepared by adding marks secured by candidates in Phase-II examination and Interview and grace marks as applicable as per extant rules.

**SYLLABI (Phase-II)**

**Paper-I** : **Economic and Social Issues (ESI)**

**Growth and Development** – Measurement of growth: National Income and per capita income – Poverty Alleviation and Employment Generation in India – Sustainable Development and Environmental issues.

**Indian Economy** – Economic History of India - Changes in Industrial and Labour Policy, Monetary and Fiscal Policy since reforms of 1991 – Priorities and recommendations of Economic Survey and Union Budget – Indian Money and Financial Markets: Linkages with the economy – Role of Indian banks and Reserve Bank in the development process - Public Finance - Political Economy - Industrial Developments in India- Indian Agriculture - Services sector in India.

**Globalization** – Opening up of the Indian Economy – Balance of Payments, Export-Import Policy – International Economic Institutions – IMF and World Bank – WTO – Regional Economic Co-operation; International Economic Issues.

**Social Structure in India** – Multiculturalism – Demographic Trends – Urbanisation and Migration – Gender Issues – Social Justice

**Suggested Reference Material:**

- Books: Indian Economy: 1. Uma Kapila (series of books) 2. Indian Economy: Misra & Puri (Latest Edition) 3. Growth and Development: Debraj Ray 4. Sociology: C.N. Shankar Rao 5. Public Finance - K K Andley and Sundaram
- Prominent Financial Newspapers
- Magazines/Periodicals/ Bulletins including RBI Bulletins, EPW, India Today, etc.
- Reports: 1. World Development Report 2. Economic Survey of India 3. RBI Annual Report 4. Report on Trend and Progress of Banking in India, Report on Currency and Finance etc. 5. IMF: World Economic Outlook
- Material sourced from RBI and BIS website

## Paper-II : English (Writing Skills)

The paper on English shall be framed in a manner to assess the writing skills including expression and understanding of the topic.

## Paper -III : General Finance and Management

### a) Financial System

1. Structure and Functions of Financial Institutions
2. Functions of Reserve Bank of India
3. Banking System in India – Structure and Developments, Financial Institutions – SIDBI, EXIM Bank, NABARD, NHB, NaBFID etc.
4. Recent Developments in Global Financial System and its impact on Indian Financial System
5. Role of Information Technology in Banking and Finance
6. Non-Banking System
7. Developments in Digital Payments

### b) Financial Markets

Primary and Secondary Markets (Forex, Money, Bond, Equity, etc.), functions, instruments, recent developments.

### c) General Topics
1. Financial Risk Management
2. Basics of Derivatives
3. Global financial markets and International Banking – broad trends and latest developments
4. Financial Inclusion
5. Alternate source of finance, private and social cost-benefit, Public-Private Partnership
6. Corporate Governance in Banking Sector
7. The Union Budget – Concepts, approach and broad trends
8. Basics of Accounting and Financial Statements - Balance Sheet, Profit and Loss, Cash Flow Statements, Ratio Analysis (such as Debt to Equity, Debtor Days, Creditor Days, Inventory Turnover, Return on Assets, Return on Equity, etc.)

9. Inflation: Definition, trends, estimates, consequences and remedies (control): WPI- CPI - components and trends; striking a balance between inflation and growth through monetary and fiscal policies

**Suggested Reference Material**

Finance

- Monetary Theory and Public Policy – Kenneth Kurihara
- Indian Economy – Mishra & Puri
- Economic Growth and Development – Meier and Baldwin
- Financial Management – Prasanna Chandra
- Major financial newspapers
- International Business by Hill and Jain
- RBI Annual Report, Report on Trend and Progress of Banking in India, Report on Currency and Finance etc.
- Economic Survey
- Material sourced from RBI website

**d) Management**

**1. Fundamentals of Management & Organizational Behaviour**

Introduction to management; Evolution of management thought: Scientific, Administrative, Human Relations and Systems approach to management; Management functions and Managerial roles; Nudge theory.

Meaning & concept of organizational behaviour; Personality: meaning, factors affecting personality, Big five model of personality; concept of reinforcement; Perception: concept, perceptual errors. Motivation: Concept, importance, Content theories (Maslow's need theory, Alderfers' ERG theory, McCllelands' theory of needs, Herzberg's two factor theory) & Process theories (Adams equity theory, Vrooms expectancy theory).

Leadership: Concept, Theories (Trait, Behavioural, Contingency, Charismatic, Transactional and Transformational Leadership; Emotional Intelligence: Concept, Importance, Dimensions. Analysis of Interpersonal Relationship: Transactional Analysis, Johari Window; Conflict: Concept, Sources, Types, Management of Conflict; Organizational Change: Concept, Kurt Lewin Theory of Change; Organizational Development (OD): Organisational Change, Strategies for Change, Theories of Planned Change (Lewin's change model, Action research model, Positive model).

**2. Ethics at the Workplace and Corporate Governance**

Meaning of ethics, why ethical problems occur in business. Theories of ethics: Utilitarianism: weighing social cost and benefits, Rights and duties, Justice and fairness, ethics of care, integrating utility, rights, justice and caring, An alternative to moral principles: virtue ethics, teleological theories, egoism theory, relativism theory, Moral issues in business: Ethics in Compliance, Finance, Human Resources, Marketing, etc. Ethical Principles in Business: introduction, Organization Structure and Ethics, Role of Board of Directors, Best Practices in Ethics Programme, Code of Ethics, Code of Conduct, etc.

Corporate Governance: Factors affecting Corporate Governance; Mechanisms of Corporate Governance.

Communication: Steps in the Communication Process; Communication Channels; Oral versus Written Communication; Verbal versus non-verbal Communication; upward, downward and lateral communication; Barriers to Communication, Role of Information Technology.

**Suggested Reference Material**

Management

- Stephen P. Robbins & Mary Coulter, Management.
- Stephen P. Robbins and Judge T.A., Vohra, Organisational Behaviour
- Dessler Gary, Warkkey Biju- Human Resource Management
- Decenzo and Robbins- Fundamentals of Human Resource Management
- Velasquez Manuel G: Business Ethics- Concepts and Cases.
- Fernando A.C.: Business Ethics – An Indian Perspective.
- Crane Andrew & Matten Dirk: Business Ethics
- Ghosh B N: Business Ethics & Corporate Governance

**Appendix-III**

### SCHEME OF SELECTION FOR OFFICERS IN GR. 'B' (DR) - DEPR /DSIM

**A. Officers in Grade 'B' (DR) – DEPR- PY 2024- Job Requirement, Scheme of Selection and Syllabus**

**(i) Job Requirements**

Primarily to undertake economic analysis and research and contribute to policy formulation, apart from compilation of data relating to select sectors.

**(ii) Scheme of Selection**

Selection will be through Online/ Written Examination (WE) and Interview. There are 4 papers for the Examination. In Phase - I of the examination, there will be Paper - I Objective Type (on Economics) and Paper-II Descriptive Type (On English). In Phase - II, there will be Paper - I Descriptive Type (on Economics) and Paper - II Descriptive Type (on Economics).

| Phase | Name of Paper | Duration | Maximum Marks |
|---|---|---|---|
| Phase - I | Paper – I : Objective Type (on Economics) | 120 minutes | 100 |
| | Paper – II : English - Descriptive (To be typed with help of keyboard) | 120 minutes | 100 |
| Phase - II | Paper – I : Descriptive Type (on Economics) (Question paper displayed on computer, answers to be written on paper) | 120 minutes | 100 |
| | Paper – II : Descriptive Type (on Economics) (Question paper displayed on computer, answers to be written on paper) | 120 minutes | 100 |
| **Total** | | | **400** |

Other detailed information regarding the examination will be given in an Information Handout, which will be made available to the candidates for download along with the Admit Card for examination from the RBI website.

Candidates have to secure minimum marks as may be prescribed by the Board.

Candidates, who secure minimum aggregate marks in Paper-I & II of Phase - I, as prescribed, will be shortlisted for Phase-II of the examination. The minimum aggregate cut-off marks for being shortlisted for Phase - II of the examination will be decided by the Board in relation to the number of vacancies.

Roll Number of the candidates shortlisted for Phase - II examination will be published on the RBI website, tentatively within a week after Phase – I examination.

(iii) **Phase-II: Paper-I/ Paper II - Descriptive Type (on Economics) Written Examination (WE)**

The Phase-II: Paper-I/ Paper-II Descriptive Type (on Economics) will be conducted on October 26, 2024 only for the candidates who are shortlisted on the basis of results of Phase-I. The Phase-I: Paper-I/Paper-II and the Phase-II: Paper-I / Paper-II Descriptive Type (on Economics) examination will be in shifts. Candidates are required to appear for all the shifts. Separate Admit Cards will be issued for each shift. The timetable for Phase-

I: Paper-I/Paper-II and Phase-II: Paper-I / Paper-II Descriptive Type (on Economics) will be intimated to the candidates concerned along with Admit Card for Phase-I and Phase-II.

(iv) Question papers for 'WE' will be set in Hindi and in English (except Paper-II on English). Answers for Phase II: Paper-I / Paper II Descriptive Type (on Economics) may be written either in Hindi or English. The Phase-I: Paper-II will have to be answered in English only. Candidates may opt for Interview in Hindi or English.

(v) The number of candidates to be called for Interview will be decided by the Board.

(vi) Final selection will be on the basis of performance in the 'Online / WE' in Phase-I (Paper - I and Paper - II), Phase-II (Paper - I and Paper - II) and Interview taken together. Interview will be of 75 marks. Candidate may opt for Interview either in Hindi or English.

(vii) Candidate shall be required to undergo Personality Assessment conducted by the Bank before appearing for the Interview. No marks will be allotted for the same and it will not form part of the final selection criteria.

(viii) Syllabi
**Phase-I: Paper-I - Objective Type (on Economics)**

(1) Microeconomics (Theories of consumer's demand; Production; Market Structures and Pricing; Distribution; and Welfare Economics)

(2) Macroeconomics (Theories of Employment, Output and Inflation; Monetary Economics; IS-LM Model; Schools of Economic Thought)

(3) International Economics (Theories of International Trade; Balance of Payments; Exchange Rate Models)

(4) Theories of Economic Growth and Development (Classical neo-classical approaches to economic growth and major theories of economic development)

(5) Public Finance (Theories of taxation and public expenditure and Public Debt Management)

(6) Environmental Economics (Green GDP, Environmental Valuation, Environmental policy instruments)

(7) Quantitative Methods in Economics (Mathematical and Statistical Methods for Economics, Ordinary Least Square Regression)

(8) Current developments in Indian Economy (Growth, inflation, poverty, unemployment, financial sector developments, external sector developments, fiscal developments, agriculture, industry, infrastructure, and services)

**Phase- I: Paper-II - Descriptive Type (on English)**

The paper on English shall be framed in a manner to assess the writing skills including expression and understanding of the topic.

**Phase– II: Paper - I - Descriptive Type (on Economics) (Question paper displayed on computer, answers to be written on paper)**

Microeconomics Module

- Consumer Theory: Cardinal and Marginal Utility Analysis, Consumer Surplus, Indifference Curve Analysis, Price, Income and Substitution Effects, Game Theory

- Production Theory: Forms of Production function; Laws of Returns to Scale; Partial Equilibrium Vs General Equilibrium Analysis

- Market Theory: Pricing under different market structures

- Distribution Theories: Ricardo, Marx, Kalecki and Kaldor

- Welfare Economics: Pareto Optimality, Schools of Welfare Thought including Arrow, Coase and Sen

Macroeconomics Module

- National Income Accounting: Various methods for measurement of National Income

- Theory of employment and Output: Classical and Neo-classical approaches, Keynesian theory of Employment and output, Post-Keynesian developments, Business Cycles

- Inflation: Types of Inflation, Philip's curve, Taylor's Rule, Lucas Critique

- Money and Banking: Quantity theory of Money, Neutrality of money, IS - LM Model and AD-AS Models, Money Multiplier, Monetary Policy – Scope, Objectives and instruments, Inflation targeting

- Theories of Economic Growth and Development: Theories of growth, Classical and neo-classical approaches, Theories of Economic Development

- International Trade and Balance of payments: Theories of international trade, Determination of exchange rates, Impossible Trinity

- Public Finance: Theories of taxation, Theories of public expenditure, Theories of public debt management

    (Equal weightage will be given to Microeconomic and Macroeconomic modules)

**Phase– II: Paper-II - Descriptive Type (on Economics) (Question paper displayed on computer, answers to be written on paper)**

Module on Quantitative Methods in Economics

- Mathematical Methods in Economics: Differentiation and Integration, Optimisation, Sets, Matrices, Linear algebra and Linear programming

- Statistical Methods in Economics: Measures of central tendency and dispersions, Probability, Time series, Index numbers.

- Econometrics and advanced Applications: Regression analysis, Panel data econometrics, Time Series econometrics, Basics of Bayesian Econometrics, Basic application of Artificial Intelligence/ Machine Learning

Module on Indian Economy – Policy and Trends

- Fiscal policy in India: Evolution, scope and limitations, current trends

- Monetary Policy in India: Evolution, Functions of the Reserve Bank of India, Monetary-Fiscal coordination, Inflation targeting, Operating framework of Monetary Policy, Current trends

- Banking and financial sector development in India: Banks and other constituents of Indian financial markets and related developments, Current trends

- Inflation in India: Trends and drivers

- External sector developments in India: Exchange rate management, external debt, Balance of payments, Current trends

- Sectoral and other developments in India: Agriculture, industry, services and social sector-related developments

(Equal weightage will be given to Quantitative Economics and Indian Economy-related modules)

ix) Suggested Reading Material

**For Phase - II (Paper-I - Micro and Macroeconomics Modules)**

• Microeconomics
  ▪ Hal R. Varian; Intermediate Microeconomics: A Modern Approach, 9th edition, 2019. The workbook, Workouts in Intermediate Microeconomics, by Hal R. Varian and Theodore C. Bergstrom may be used for problems.
  ▪ A. Koutsoyiannis; Modern Microeconomics, International Edition.
  ▪ C.E. Ferguson and J.P. Gould; Microeconomic Theory.
• Macroeconomics
  ▪ Dornbusch, Fischer and Startz; Macroeconomics, McGraw Hill, 13th edition, 2018.
  ▪ Olivier Blanchard; Macroeconomics, Pearson Education, Inc., 8th edition, 2021.
  ▪ Brian Snowdon and Howard R. Vane; Modern Macroeconomics: Its Origin, Development and Current State, Edward Elgar Publishing Ltd, 2005.
• International Economics
  ▪ Paul R. Krugman, Maurice Obstfeld and Marc Melitz; International Economics: Theory and Policy, Pearson Education, 12th edition, 2022.
  ▪ Dominick Salvatore; International Economics: Trade and Finance, Wiley, 11th edition, 2014.
• Public Finance
  ▪ Richard A. Musgrave and Peggy B. Musgrave; Public Finance in Theory and Practice, McGraw Hill, 5th edition, 2017.
  ▪ Stiglitz, J.E. and Jay K. Rosengard Economics of the Public Sector, W.W. Norton & Company, 4th edition, 2015.
• Growth and Development
  ▪ A.P. Thirlwall; Economics of Development: Theory and Evidence, Macmillan, 9th edition, 2011.
  ▪ Debraj Ray, Development Economics, Oxford University Press, 2009.
  ▪ Basu, K., Analytical Development Economics, The Less Developed Economy Revisited, MIT Press, 2003

**For Phase - II (Paper-II - Modules on Quantitative Methods in Economics and Indian Economy)**

• Mathematical Methods in Economics
  ▪ Simon, Carl P. and Lawrence Blume; Mathematics for Economists, W. W. Norton & Company, Inc., 1994.
  ▪ Kevin Wainwright and Alpha C. Chiang; Fundamental Methods of Mathematical Economics, 4th edition, McGraw-Hill, 2005
• Econometrics
  ▪ D. N. Gujarati and D.C. Porter; Essentials of Econometrics, McGraw-Hill, 4th edition, International Edition, 2010.
  ▪ Wooldridge, J.M; Introductory Econometrics: A Modern Approach, Cengage Learning, 7th edition, 2022.
• Statistics
  ▪ N. G. Das; Statistical Methods, McGraw-Hill, 2008.

- Miller, I., Miller, M.; John E. Freund's Mathematical Statistics with Applications, 8th edition, Pearson, 2021.

• Indian Economy
- Economic Survey, Government of India, Various Issues
- India Development Report, Oxford University Press, Various Issues.
- Uma Kapila, Indian Economy since Independence, Academic Foundation, Various Issues.
- RBI Annual Report – Last two years.
- RBI Report on Trends and Progress of Banking in India – Last two years.
- Monetary Policy Reports – Last two years.
- Financial Stability Report – Last two years

## B. Officers in Grade 'B' (DR) – DSIM- PY 2024- Job Requirement, Scheme of Selection and Syllabus

### (i) Job Requirements

To undertake collection, compilation, analysis and interpretation of data on banking, corporate and external sectors; Modelling and forecasting of inflation, growth and other important macroeconomics indicators; Analytical studies involving statistical/econometric models in the operational areas of interest to the Reserve Bank; planning, designing and organizing sample surveys; maintaining technology-driven centralized reporting system and Data warehouse for information management /dissemination; and Development of methodology for the measurement and estimation of variables and improvement of the database of various sectors of the economy. Application of Data Science/Artificial Intelligence/Machine Learning techniques to derive insights from large volume data.

### (ii) Scheme of Selection

Selection will be through Online/ Written Examination (WE) and Interview. There are 3 papers for the Examination. Paper-I Objective Type (on Statistics**)** to be held on **September 14, 2024** and Paper-II & III will be held on **October 26, 2024** (date to be confirmed in Admit Cards).

| Name of Paper | Duration | Maximum Marks |
|---|---|---|
| Paper-I : Objective Type (on Statistics) | 120 minutes | 100 |
| Paper-II : Descriptive Type (on Statistics) (Question paper displayed on computer, answers to be written on paper) | 180 minutes | 100 |
| Paper-III : English – Descriptive (To be typed with help of keyboard) | 90 minutes | 100 |
| **Total** | | **300** |

Other detailed information regarding the examination will be given in an Information Handout, which will be made available to the candidates for download along with the Admit Card for examination from the RBI website.

Candidates have to secure minimum marks as may be prescribed by the Board.

Candidates, who secure minimum aggregate marks in Paper-I, as prescribed, will be shortlisted for Paper-II and Paper-III of the examination based on the aggregate marks obtained in Paper-I. The minimum aggregate cut-off marks for being shortlisted for Paper-II and Paper-III of the examination will be decided by the Board in relation to the number of vacancies. Roll Number of the candidates shortlisted for Paper-II and Paper-III examination will be published on the RBI website, tentatively within a week after Paper-I examination.

**(iii) Paper – II and Paper-III  - Online/Written Examination**

The Paper-II and Paper-III Examination will be conducted on **October 26, 2024** only for the candidates who are shortlisted on the basis of results of Paper-I. The Paper-II and Paper-III examination will be in shifts. Candidates are required to appear for all shifts. Separate Admit Cards will be issued for each shift. The timetable for Paper-II and Paper-III will be intimated to the candidates concerned along with Admit Card for Paper-II and Paper-III.

(iv) Question papers for 'WE' will be set in Hindi and in English (except Paper-III on English). Answers for Paper-II may be written either in Hindi or English. Paper-III will have to be answered in English only. Candidates may opt for Interview in Hindi or English.

v) The number of candidates to be called for the Interview will be decided by the Board.

vi) Final selection will be on the basis of performance in the 'Online / WE' (Paper-I, II and III) and Interview taken together. Interview will be of 75 marks.  Candidate may opt for Interview either in Hindi or English.

vii) Candidate shall be required to undergo Personality Assessment conducted by the Bank before appearing for the Interview. No marks will be allotted for the same and it will not form part of the final selection criteria.

**Syllabi**

Standard of papers would be that of Master's Degree examination of any Central University in India.

**Paper-I**

Questions would cover Probability: Definition of Probability, Standard distribution, Large and small sample theory, Analysis of Variance, Estimation, Testing of Hypotheses, Multivariate analysis and Stochastic Processes.

**Paper-II**

Questions would cover (i) Probability and Sampling, (ii) Linear Models and Economic Statistics, (iii) Statistical Inference: Estimation, Testing of hypothesis and Non-parametric Test, (iv) Stochastic Processes, (v) Multivariate analysis, (vi) Econometrics and time series,  (vii) Statistical computing; and (viii) Data Science, Artificial Intelligence and Machine Learning Techniques.

**Detailed Syllabus**

**1.   Theory of Probability and Probability Distributions**

Classical and axiomatic approach of probability and its properties, Bayes Theorem and its application, strong and weak laws of large numbers, characteristic functions, central limit theorem, probability inequalities.

Standard probability distributions – Binomial, Poison, Geometric, Negative binomial, Uniform, Normal, exponential, Logistic, Log-normal, Beta, Gamma, Weibull, Bivariate normal etc.

Exact Sampling distributions - Chi-square, student's t, F and Z distributions and their applications. Asymptotic sampling distributions and large sample tests, association and analysis of contingency tables.

**Sampling Theory:**

Standard sampling methods such simple random sampling, Stratified random sampling, Systematic sampling, Cluster sampling, Two stage sampling, Probability proportional to size etc. Ratio estimation, Regression estimation, non-sampling errors and problem of non-response, and Correspondence and categorical data analysis.

## 2. Linear Models and Economic Statistics

Simple linear regression - assumptions, estimation, and inference diagnostic checks; polynomial regression, transformations on Y or X (Box-Cox, square root, log etc.), method of weighted least squares, inverse regression. Multiple regression - Standard Gauss Markov setup, least squares estimation and related properties, regression analysis with correlated observations. Simultaneous estimation of linear parametric functions, Testing of hypotheses; Confidence intervals and regions; Multicollinearity and ridge regression, LASSO.

Definition and construction of index numbers, Standard index numbers; Conversion of chain base index to fixed base and vice-versa; base shifting, splicing and deflating of index numbers; Measurement of economic inequality: Gini's coefficient, Lorenz curves etc.

## 3. Statistical Inference: Estimation, Testing of Hypothesis and Non-Parametric Test

### Estimation

Concepts of estimation, unbiasedness, sufficiency, consistency and efficiency. Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE), Rao-Blackwell and Lehmann-Scheffe theorems and their applications. Cramer-Rao inequality.

### Methods of Estimation

Method of moments, method of maximum likelihood estimation, method of least square, method of minimum Chi-square, basic idea of Bayes estimators.

### Principles of Test of Significance

Type-I and Type-II errors, critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test, Neyman Pearson theory of testing of hypothesis. Likelihood ratio tests, Tests of goodness of fit. Bartlett's test for homogeneity of variances.

### Non-Parametric Test

The Kolmogorov-Smirnov test, Sign test, Wilcoxon Signed-rank test, Wilcoxon Rank-Sum test, Mann Whitney U-test, Kruskal-Walls one way ANOVA test, Friedman's test, Kendall's Tau coefficient, Spearman's coefficient of rank correlation.

## 4. Stochastic Processes

### Poisson Processes

Arrival, interarrival and conditional arrival distributions. Non-homogeneous Processes. Law of Rare Events and Poisson Process. Compound Poisson Processes.

### Markov Chains

Transition probability matrix, Chapman- Kolmogorov equations, Regular chains and Stationary distributions, Periodicity, Limit theorems. Patterns for recurrent events. Brownian Motion - Limit of Random Walk, its defining characteristics and peculiarities; Martingales.

## 5. Multivariate Analysis

Multivariate normal distribution and its properties and characterization; Wishart matrix, its distribution and properties, Hotelling's T2 statistic, its distribution and properties, and its applications in tests on mean vector, Mahalanobis' D2 statistics; Canonical correlation analysis, Principal components analysis, Factor analysis and cluster analysis.

## 6. Econometrics and Time Series

General linear model and its extensions, ordinary least squares and generalized least squares estimation and prediction, heteroscedastic disturbances, pure and mixed estimation. Auto correlation, its consequences and related tests; Theil BLUS procedure, estimation and prediction; issue of multi-collinearity, its implications and tools for handling it; Ridge regression.

Linear regression and stochastic regression, instrumental variable regression, autoregressive linear regression, distributed lag models, estimation of lags by OLS method. Simultaneous linear equations model and its generalization, identification problem, restrictions on structural parameters, rank and order conditions; different estimation methods for simultaneous equations model, prediction and simultaneous confidence intervals.

Exploratory analysis of time series; Concepts of weak and strong stationarity; AR, MA and ARMA processes and their properties; model identification based on ACF and PACF; model estimation and diagnostic tests; Box-Jenkins models; ARCH/GARCH models.

### Inference with Non-Stationary Models

ARIMA model, determination of the order of integration, trend stationarity and difference stationary processes, tests of non-stationarity.

### 7. Statistical Computing

Simulation techniques for various probability models, and resampling methods jack-knife, bootstrap and cross-validation; techniques for robust linear regression, nonlinear and generalized linear regression problem, tree-structured regression and classification; Analysis of incomplete data – EM algorithm, single and multiple imputation; Markov Chain Monte Carlo and annealing techniques, Gibbs sampling, Metropolis-Hastings algorithm; Neural Networks, Association Rules and learning algorithms.

### 8. Data Science, Artificial Intelligence and Machine Learning Techniques

Introduction to supervised and unsupervised pattern classification; unsupervised and reinforcement learning, basics of optimization, model accuracy measures.

### Supervised Algorithms

Linear Regression, Logistic Regression, Penalized Regression, Naïve Bayes, Nearest Neighbour, Decision Tree, Support Vector Machine, Kernel density estimation and kernel discriminant analysis; Classification under a regression framework, neural network, kernel regression and tree and random forests.

### Unsupervised Classification

Hierarchical and non-hierarchical methods: k-means, k-medoids and linkage methods, Cluster validation indices: Dunn index, Gap statistics.

Bagging (Random Forest) and Boosting (Adaptive Boosting, Gradient Boosting) techniques; Recurrent Neural Network (RNN); Convolutional Neural Network; Natural Language Processing.

### Paper-III

English: The paper on English shall be framed in a manner to assess the writing skills including expression and understanding of the topic.

### Suggested Reading Material:

### For Paper-I and Paper-II

- **Theory of Probability and Probability Distributions**
    - Rohatgi, V. K. and Saleh, A.K. Md. E. (2005). An Introduction to Probability and Statistics
    - Goon, A.M., Gupta, M.K. and Dasgupta. B. (1985). An Outline of Statistical Theory Vol- I & II
    - Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. and Asok, C. (1984). Sampling Theory of Surveys with Applications
    - S. C. Gupta, V. K. Kapoor (2000). Fundamentals of Mathematical Statistics
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**C. Manner of conduct of examinations for Grade 'B' (DR)-DEPR /DSIM**

**DEPR :**

(i) The examination will be conducted on two days i.e. Phase-I (Paper-I & II) (Online Examination) on **September 14, 2024** and Phase-II (Paper-I & II) (Online / Written Examination) will be held separately on **October 26, 2024** (date to be confirmed in Admit Cards).

(ii) Phase-I : Paper-I - Objective Type (on Economics) will be conducted online and comprise multiple choice questions. Paper-II - Descriptive Type (on English) to be typed with help of keyboard.

(iii) Phase-II : Paper-I & II will be a Descriptive Type (on Economics) pen / paper based examination where the questions will be displayed on computer screen, answers to be written on paper.

**DSIM :**

(i) The examination will be conducted on two days i.e. Paper-I on **September 14, 2024** and Paper-II & III will be held separately on **October 26, 2024** (date to be confirmed in Admit Cards).

(ii) Paper - I (Objective type on Statistics) will be conducted online and comprise multiple choice questions.

(iii) Paper - II (on Statistics) will be a Descriptive Type pen/paper based examination where the questions will be displayed on computer screen, answers to be written on paper.

(iv) Paper –III (English) will be of Descriptive Type where the candidates will be expected to type out answers on a computer.

**The Board reserves the right to modify the exam dates and time entirely at its discretion.**