



## **PhD Entrance Exam (2018) Syllabus**

**Maximum Marks: 50 (10 Marks on Research Methodology & 40 Marks on Subject)**

**Exam Type: MCQ with no negative marking**

**Duration of Exam: 1 Hour**

## **Research Methodology (10 marks) (Mandatory for all streams)**

### **I. Research Aptitude**

Research: Meaning, characteristics and types; Steps of research; Methods of research; Research Ethics; Research problem, Meaning of research problem, Sources of research problem, Characteristic of a good research problem. Hypothesis: meaning of hypothesis, Research proposal or synopsis

### **II. Reasoning (Including Mathematical)**

Number series; letter series; codes; Relationships; classification.

### **III. Logical Reasoning**

Understanding the structure of arguments; Evaluating and distinguishing deductive and inductive reasoning; Verbal analogies: Word analogy — Applied analogy; Verbal classification. Reasoning Logical Diagrams: Simple diagrammatic relationship, multidiagrammatic relationship; Venn diagram; Analytical Reasoning.

### **IV. Information and Communicating Technology (ICT)**

ICT : meaning, advantages, disadvantages and uses; General abbreviations and terminology; Basics of internet and e-mailing, Microsoft office 2007 and 2010.



## **Subject Specific syllabus: (40 marks)**

### **Management and Commerce:**

#### **Unit – I – Managerial Economics:**

Demand Analysis, Production Function, Cost – Output Relations, Market Structures, Pricing Theories, Advertising Macro – Economics, National Income Concepts, Infrastructure – Management and Policy Business Environment

#### **Unit – II – Organisational Behaviour:**

The concept and significance of organisational behaviour – Skills and Roles in an organisation – Classical, Neo – Classical and Modern Theories of Organisational Structure – Organisational Design – Understanding and Managing individual behaviour personality – Perception – Values – Attitudes – Learning – Motivation, Understanding and Managing Group Behaviour, Processes – Inter – personal and group dynamics – Communication – Leadership – Managing change – Managing conflicts, Organisational Development.

#### **Unit – III – Human Resource Management (HRM):**

Concepts and perspectives in HRM, Human Resource Management (HRM) – Significance; Objectives; Functions; A diagnostic model; External and Internal environment; HRM in changing environment, Forces and Influences; Organizing HRM function, Human Resource Planning – Objectives, Process and Techniques, Recruitment and Selection – Sources of recruits; Recruiting methods; Selection procedure; Selection tests; Placement and Follow-up, Job analysis – Job Description, Job Evaluation, Potential Assessment, Selecting Human Resources, Induction, Training and Development. Development of Personnel – Objectives; Determining Needs; Methods of Training & Development programs; Evaluation, Performance Appraisal and Evaluation. Performance Appraisal System – Importance and Objectives; Techniques of appraisal system; New trends in appraisal system, Wage and salary administration; Fringe



Benefits; Human resource records and audit, Employee Discipline – importance; causes and forms; Disciplinary action; Domestic enquiry, Industrial Relations and Trade Unions. Industrial Relations – Importance; Industrial conflicts; Causes; Dispute settlement machinery, Industrial Democracy and Employee Participation – Need for industrial democracy; Pre – requisites for industrial democracy; Employee Participation – Objectives; Forms of Employee Participation, Trade Unions – Importance of Unionism; Union leadership; National Trade Union Movement, Collective Bargaining – Concept; Process; Pre-requisites; New trends in collective bargaining

#### **Unit – IV – Financial Management:**

Financial Management – Nature and Scope, Valuation Concepts and Valuation of Securities, Valuation Concepts – Risk and Return; Valuation of Securities; Pricing Theories – Capital asset pricing model and Arbitrage pricing theory – Understanding financial statements and analysis thereof, Capital Budgeting Decisions – Risk Analysis, Capital budgeting decisions; Risk analysis in capital budgeting and Long – Term sources of finance, Capital Structure – Theories and Factors; Cost of capital, Dividend Policies – Theories and Determinants, Long – Term and Short – Term Financing Instruments, Working Capital Management – Determinants and Financing; Cash management; Inventory management; Receivables management, Mergers and Acquisitions, Elements of Derivatives, Corporate risk management, International Financial Management.

#### **Unit – V- Marketing:**

Marketing – Concept; Nature and Scope; Marketing myopia; Marketing mix; Different environments and their influences on marketing; Understanding the customer and competition.

Role and Relevance of Segmentation and Positioning; Marketing Environment and Environment Scanning; Marketing Information Systems and Marketing Research; Understanding Consumer and Industrial Markets; Demand Measurement and Forecasting;

Product Decisions, Product mix, Product Life Cycle; New Product Development; Branding and Packaging; Pricing objectives; Pricing concepts; Pricing Methods and Strategies.



Promotion Decisions – Promotion mix; Advertising; Personal Selling; Channel Management; Vertical Marketing Systems; Evaluation and Control of Marketing Effort; Marketing of Services; Customer Relation Management;

Distribution channel hierarchy; Role of each member in the channel; Analysis of business potential and evaluation of performance of the channel members.

Wholesaling and Retailing – Different types and the strengths of each one; Emerging issues in different kinds of retailing in India.

Consumer Behaviour theories and models and their specific relevance to marketing managers.

Use of internet as a medium of marketing; Managerial issues in reaching consumers / organisation through internet.

#### **Unit – VI – Production Management:**

Role and Scope of Production Management; Facility Location; Layout Planning and Analysis; Production Planning and Control – Production Process Analysis; Demand Forecasting for Operations; Determinants of Product mix; Production Scheduling; Work measurement; Time and Motion Study; Statistical Quality Control. Queueing Theory; Decision Theory; PERT / CPM.

#### **Unit – VII – Statistics and Probability:**

Probability Theory; Probability distributions – Binomial, Poisson, Normal and Exponential; Correlation and Regression analysis; Sampling theory; Sampling distributions; Tests of Hypothesis; Large and small samples; t z, F, Chi – square tests.

#### **Unit – VIII – Strategic Management:**

Concept of Corporate Strategy; Components of Strategy Formulation; Ansoffs Growth Vector; BCG Model; Porter's Generic Strategies; Competitor Analysis; Strategic Dimensions and Group Mapping; Industry Analysis; Strategies in Industry Evolution, Fragmentation, Maturity, and decline.



Competitive strategy and Corporate Strategy; Transnationalization of World Economy; Managing Cultural Diversity; Global Entry Strategies; Globalization of Financial System and Services; Managing International Business; Competitive Advantage of Nations; RTP and WTO.

## **Computer Science: -**

### **1. Data Structures, Algorithms and Programming Language**

#### Data structures

Stacks, queues, trees, graphs, binary search trees, heaps and priority queues, hash tables. The order notations, worst-case and average-case performance of algorithms, notions of lower bounds on problem complexity and optimality of algorithms.

Linear and binary search. Bubble sort, insertion sort, selection sort, merge sort, quick sort, heap sort, counting sort.

#### Algorithm design techniques

Divide-and-conquer, greedy, and dynamic programming algorithms.

Preorder, Inorder and Postorder traversal of trees, BFS and DFS, topological sort. Minimum spanning trees (Kruskal's and Prim's algorithms), Shortest path (Dijkstra and Floyd-Warshall algorithms).

#### C programming

Datatypes, variables, assignment statements, iteration and control statements, arrays, structures, functions and recursion, pointers. Stack, queue, binary tree, binary search tree.

### **2. Discrete Mathematics, Formal Languages and Automata Theory**

#### Proof techniques

Direct proofs, proof by contraposition, proof by contradiction, proof by cases, existence proofs. Proofs by mathematical induction.

#### Sets & Functions

Subsets, set equality, set operations: complement, union, intersection, set difference, Powersets, Injective, surjective, bijective functions, Composition of functions. Inverse of a function, Properties of relations, Equivalence relations, Partial Orderings, Principle of inclusion-exclusion, pigeon-hole principle, Permutations and Combinations, Linear recurrence relations, divide and conquer recurrence relations.



### Discrete probability

Probability of combinations of events, Conditional probability, Independence, Bayes Theorem, Expected values.

### Languages and grammars

Alphabets, Strings, Languages, Grammars and Recognizers, Decision problems over languages.

Regular languages (RLs), Regular Grammars and Regular Expressions, DFAs, NFAs and their equivalence with Regular Grammars and Regular Expressions, Converting NFA to DFA, Proving Languages not to be Regular -- pumping lemma for RLs, Closure of RLs under Boolean operations, Context-free languages (CFLs), CFGs, Parse trees, Pushdown Automata (PDAs).

## **3. Digital Logic, Computer Org. & Architecture and Operating Systems**

### Switching theory & Combinational logic circuits

Boolean algebra, logic gates, and switching functions, truth tables and switching expressions, minimization of switching functions, Karnaugh map, Realization of Boolean functions using gates and multiplexers, Flip-flops, registers and counters, basic design of FSMs.

### Instruction set architecture

Instruction types, Instruction formats, addressing modes, Representation of fixed and floating-point numbers, 2's complement arithmetic.

### Control unit & Memory systems

Organization of a CPU, control and data paths, register-transfer level specifications, Concept of memory hierarchy, cache memory, cache performance, cache-main memory mapping.

### Input-output systems

Programmed I/O, Interrupt-driven I/O, polling and vectored interrupt, basic concept of DMA transfer, Privileged mode and privileged instructions, handling of hardware and software interrupts.

### Basics of operating systems

Basic concepts, process state transition diagram, context switch, process synchronization problem, semaphores - definition and implementation, Pre-emptive and non-pre-emptive



scheduling, FCFS, SJF and round-robin scheduling, Logical and physical addresses, paging and virtual memory, Page table.

## **Electronics Engineering :**

As per GATE syllabus.

## **Applied Mathematics:**

### **Module 1 : Real Analysis**

Elementary set theory, Finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, Supremum, Infimum. Sequences and series: Convergence, limsup, liminf, Bolzano Weierstrass theorem, Heine-Borel theorem. Continuity, Uniform continuity, Differentiability, Mean value theorems. Sequences and series of functions, Uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, Types of discontinuity, Functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, Partial derivative, Derivative as a linear transformation, Inverse and Implicit function theorems. Metric spaces, Compactness, Connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

### **Module 2 : Linear Algebra**

Vector spaces, Subspaces, Linear dependence, Basis, Dimension, Algebra of linear transformations. Algebra of matrices, Rank and Determinant of matrices, Linear equations. Eigenvalues and Eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, Canonical forms. Inner product spaces, Orthonormal basis. Quadratic forms.

### **Module 3 : Complex Analysis**

Algebra of complex numbers, Complex plane, Polynomials, Power series, Transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, Calculus of residues. Conformal mappings, Mobius transformations.



#### **Module 4 : Algebra**

Permutations, Combinations, Pigeon-hole principle, Inclusion-exclusion principle. Fundamental theorem of arithmetic, Divisibility in  $\mathbb{Z}$ , Congruences, Chinese Remainder Theorem. Groups, Subgroups, Normal subgroups, Quotient groups, Homomorphisms, Cyclic groups, Permutation groups, Cayley's theorem. Rings, Ideals, Prime and Maximal Ideals, Quotient rings, Unique factorization domain, Principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, Finite fields, Field extensions, Galois Theory. Topology: Basis, Dense sets, Subspace and Product topology, Separation axioms, Connectedness and Compactness.

#### **Module 5 : Ordinary Differential Equations (ODEs)**

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, Singular solutions of first order ODEs, System of first order ODEs. General theory of homogeneous and non-homogeneous linear ODEs, Method of variation of parameters, Sturm-Liouville boundary value problem, Green's function.

#### **Module 6 : Partial Differential Equations (PDEs)**

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

#### **Module 7 : Numerical Analysis**

Numerical solutions of algebraic equations, Method of Iteration and Newton-Raphson's method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and Spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

#### **Module 8 : Calculus of Variations**

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

#### **Module 9 : Linear Integral Equations**

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, Resolvent kernel.





## **Module 10 : Probability and Statistics**

Review of basic probability, Random variables, Probability Distribution of discrete and continuous random variables, Joint distributions, Expectation, Mean and Variance of discrete, continuous and joint distributions, Standard distributions - Binomial, Geometric, Poisson, Uniform, Normal and Exponential distributions.