



आई सी एम आर – राष्ट्रीय यक्ष्मा अनुसंधान संस्थान
स्वास्थ्य अनुसंधान विभाग, स्वास्थ्य और परिवार
कल्याण मंत्रालय, भारत सरकार

ICMR - National Institute for Research in Tuberculosis
Department of Health Research, Ministry of Health
and Family Welfare, Government of India

No.ICMR-NIRT/Tech.Recrut/02/2023/

Date: 15.11.2023

SUBJECT SYLLABUS FOR COMPUTER-BASED TEST

With reference to the notification issued by ICMR-NIRT for filling up of technical posts under various disciplines vide notification No.ICMR-NIRT/Tech.Recrut/02/2023 dated 26.09.2023, the indicative Subject Syllabus for Computer-Based Test is as follows:

Post Code: TO-B-01

Discipline: Clinical Pharmacology

Pharmacology/Medical Pharmacology:

Anatomy

Human Gross Anatomy

Neuroanatomy, Microanatomy and History of Anatomy

Developmental Anatomy, Genetics,

Recent Advances, Comparative Anatomy & Evolution

Bio-chemistry

General Bio-Chemistry & Metabolism

Nutrition, Environmental & Clinical Biochemistry

Molecular Biology & Immunology, Biostatistics & Research methodology

Microbiology

General Bacteriology and Immunology

Systematic Bacteriology and Clinical Microbiology

Virology, Mycology, Parasitology and Recent Advanced in Microbiology

Pharmacology

General Pharmacology, Systemic Pharmacology and Mechanism of Drug Action

Experimental Pharmacology, Bioassay and Biostatistics

Clinical Pharmacokinetics

Fundamentals of Clinical Research

Recent Advances and Biochemical Pharmacology

Physiology

Bio-Physics and Bio-Chemistry and Physiology, Histology of Muscles, Nervous, Circulation and Respiration.

Comparative Animal Physiology and History of Physiology, Genetics and Principles of Biostatistics

Biochemistry/Medical Biochemistry:

Anatomy

Biochemical Techniques

Bioenergetics and Biomembranes

Bioinformatics

Biomolecules

Biophysical Chemistry

Biostatistics

Cell Biology

Clinical Biochemistry

Drug metabolism
Endocrinology
Enzymology
Genetics
Human Nutrition
Immunology
Intermediary Metabolism
Microbiology
Molecular Biology
Physiology
Structural Biology

Post Code: TO-B-02

Discipline: Cyber Security

Cyber Security Objectives, Cyber Security Fundamentals, Types of Malware, Cyber Security Breaches, Types of Cyber Attacks, Prevention Tips, Mobile Protection, Social Network Security, Prevention Software, Cyber Security Ecosystem, Current Cyber Security Threats, Cyber Security Concepts, Information Security and Privacy, CIA Triad, Cyber Security Vs Information Security, Risk Management, Cyber Threats which are real, Threat Modelling, Security Awareness & Training, Protection of Information Assets, Data Security Controls, Secure Data Handling, Enterprise Security Architecture, Threat & Vulnerability Management, Cyber Attack Life Cycle, Overview of Security Assessment-approach & methodology Data Security & Privacy – by Design & Default, Software Development Life Cycle / SecDevOps, EU GDPR, Data Protection Act, Right of the Data Subject, Role of a Data Officer, Six Data Protection Principles Data Controller and Processor, Data Protection Impact Assessment(DPIA), Common Data Breaches/Security Incidents, Data Protection and Privacy Compliance Framework, Building Cyber Defence, Cyber Security Strategy
Basic Dynamic Analysis
Malware Analysis Introduction.
Cryptography and Encryption.
Digital Forensics.
Network Programming.
String and Data Manipulation.
Protect against various types of cyber attacks, such as phishing scams and malware infections
Cyber Security Essentials and Incident Response Management – Cyber Security Audit and Compliance – Web Application Security – Network Security and Forensics – Incident response and Threat Intelligence – Forensic Science and Cyber Law in India.
Artificial Intelligence and Data Science – Computer Forensics – Mobile Security and Forensics – Malware Analysis, Reverse Engineering and Exploit Writing – Code Review and Scripting, Threat Hunting and Scripting – Malware Analysis – Advanced Digital Forensics.
Blockchain and Cryptocurrencies – Mobile Phone Security – IoT Security - Cloud Security, Critical Infrastructure Security and Research Methodology – Machine Learning of Cyber Security.

Post Code: TO-B-03

Discipline: Electrical Engineer

Digital logic circuits:

Simplify the logical expressions using Boolean functions.

Study implementation of combinational circuits.

Digital simulation for development of application oriented logic circuits.

Electromagnetic theory

The basic mathematical concepts related to electromagnetic vector fields.

The concepts of Faraday's law, induced EMF and Maxwell's equations.

The concepts of concepts of electromagnetic waves and pointing vector,

The concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications

Linear integrated circuits and applications

The IC fabrication procedure.

Design for signal analysis using op-amp IC'S.

Internal functional blocks and the applications of special like timers, Phase Locked Loop

Electronic devices and circuits

The structure of basic electronic devices.

Operation and applications of electronic devices.

Electrical machines – I

Techniques of magnetic-circuit analysis and introduce magnetic materials.

The constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.

Working principles of DC machines as generator types, determination of their load characteristics, starting and methods of speed control of motors.

Transmission and distribution

Develop expressions for the computation of transmission line parameters, modelling and performance of transmission lines, transmission line parameters.

Discrete time systems and signal processing

Discrete time system analysis.

Discrete Fourier transform & computation.

Digital signal processors.

Measurements and instrumentation

Electrical and electronics instruments.

Comparison methods of measurements.

Transducers and data acquisition systems.

Power system analysis

Power flow analysis.

Fault analysis – Balanced faults.

Fault analysis – unbalanced faults.

Microprocessors and microcontrollers

The architecture of Micro processor8085 & Micro controller8051.

Peripheral interfacing.

Micro controller programming & applications.

Power plant engineering

Coal based thermal power plants.

Gas turbine and combined cycle power plants.

Nuclear power plants, energy, economic and environmental issues of power plants.

Power electronics

Power semi-conductor devices.

Phase-controlled converters.

Inverters.

Electrical machines – II

Synchronous generator.

Synchronous motor.

Single phase induction motors and special machines.

Control systems

Systems and their representation.

Stability and compensator design.

Communication engineering

Analog and digital communication.

Multiple access techniques

Solid state drives

Synchronous motor drives

Embedded systems

Embedded networking.

Embedded firmware development environment.

Embedded system application development.

Design of electrical machines

DC machines.

Transformers.

Induction motors

High voltage engineering

Over voltages in electrical power systems.

Generation of high voltages and high currents.

High voltage testing & insulation coordination.

Protection and switchgear

Electromagnetic relays.

Static relays and numerical protection.

Circuit breakers.

Special electrical machines

Synchronous reluctance motors.

Permanent magnet brushless DC motors.

Permanent magnet synchronous motors.

Electric energy generation, Utilization and conservation

Electric drives and traction.

Heating and welding.

Solar radiation and solar energy collectors.

Visual languages and applications

Fundamentals of windows and MFC (Microsoft Foundation class).

Resources and controls, document / view architecture

Power system transients

Switching transients.

Lightning transients.

Transients in integrated power system.

Fiber optics and laser instruments

Optical fibers and their properties.

Industrial application of lasers.

Hologram and medical applications.

Post Code: TO-B-04

Discipline: Statistics

MULTIVARIATE STATISTICAL ANALYSIS

Multivariate Normal distribution: Properties – Marginal and conditional distributions. The Moment generation function and moments. Distribution of linear combinations – Distribution of the exponent term of the Multivariate normal distribution- Partial and multiple correlation co-efficients.

The Maximum Likelihood estimation of the parameters of Multivariate Normal and their sampling distributions – Inference concerning the mean vector when covariance matrix is known. Distribution of correlation coefficient when population correlation coefficient is equal to zero – Distribution of Regression coefficients.

Hotelling- T^2 distribution: Applications – Derivation of generalized T^2 statistic and its distribution – Uses of T^2 statistics – optimum properties of T^2 statistic – Mahalanobis- D^2 Statistic and its distribution – Relation between T^2 and D^2 . Generalised variance – Wishart distribution and its properties.

Principal components: Definition – Maximum likelihood estimates of the Principal components and their variances. Factor Analysis: The Mathematical model – Estimation of Factor Loadings – Varimax rotation – Numerical solution of the estimating equations – testing Goodness of Fit of the Factor Model. Canonical Correlation: Estimation of Canonical correlation and variates. Discrimination and Classification – Fisher's method - Classification into one of two populations (known and unknown distributions) – Classification into one of several populations – Optimality of classification rules. Cluster Analysis: Similarity measures, Hierarchical and K-means clustering.

STATISTICAL ESTIMATION THEORY

Point Estimation:

Introduction - Minimum mean square error criterion - Unbiased estimators – Consistent estimators – Sufficient Statistics – Fisher's information measure - Minimal Sufficient Statistics – Complete Statistics – Exponential families of distributions – Pitman families of distributions. Minimum variance unbiased estimators (UMUE):

Introduction - Uniformly Minimum Variance Unbiased Estimator (UMVUE) – Lower bounds for variance of unbiased estimators: Cramer – Rao inequality – Cramer – Rao lower bound – Bhattacharyya lower bound - Bhattacharyya inequality – Chapman – Robbins inequality – Use of sufficient and complete statistics: Rao-Blackwell Theorem - Lehmann-Scheffe theorem.

Methods of Estimation:

Introduction – Method of Moments – Method of Maximum Likelihood – Properties of the Maximum Likelihood Estimators – Method of Minimum Chi—square – Method of Least Squares.

Parametric point estimation:

Bias, Unbiased, Consistent, Minimum Variance Unbiased (MVU), Mean-Squared Error (MSE). Uniformly minimum variance unbiased estimators (UMUE).

Methods of estimation:

Method of moments and Method of maximum likelihood of the following distributions:

Binomial, Poisson, Normal, Uniform, Exponential, Gamma and Laplace.

Interval Estimation:

Mean, Difference of means, Proportion, Difference of proportions, Variance and Ratio of variance for Small and Large samples. Shortest with confidence interval.

Bayes' estimation:

Prior, posterior and conjugate priors.

ADVANCED DISTRIBUTION THEORY

Power series distributions – Compound distributions: Compound Binomial and Poisson distributions. Multinomial distribution. Truncated distributions: left truncated binomial – left truncated Poisson, Zero Inflated Poisson distribution, Zero Inflated Negative Binomial distribution.

Some Special univariate distributions: Exponential, Laplace, logistic, log-normal, beta, gamma, Cauchy and Weibull distributions. Truncated Exponential, Gamma and Cauchy distributions and Left and Right truncated Normal distribution – Non-Central Chi-Square, t, and F distributions.

Transformation of Random variables: Jacobian transformation – Discrete and Continuous distributions. Bivariate distributions: Bivariate Binomial, Bivariate Poisson, Bivariate Exponential and Bivariate Normal distributions – M.G.F. – Moments.

SAMPLING TECHNIQUES

Varying probability Sampling : Cumulative total method and Lahiri's method. Estimation in PPS sampling with replacement, and without replacement; General selection procedures, Narian's Scheme of sample selection and Sen-Midzno method – Ordered estimator: Des Raj, Unordered estimators : Hurwitz – Thompson estimator and Murthy's estimator.

Cluster Sampling : Equal cluster sampling – Estimators of mean and variance, optimum cluster size, Unequal cluster sampling – Estimators of mean and variance, varying probability cluster sampling – Two stage sampling – variance of the estimated mean – Three stage sampling – variance of the estimated mean Multiphase sampling : Double sampling for stratification – Optimum allocation – Estimated variance in Double sampling for stratification. Sources of errors in Surveys – A mathematical model of the effects of call-backs – a mathematical model of the errors of measurement – Interpenetrating sub sampling method.

PROBABILITY THEORY

Probability measures – Marginal and Conditional probability – Random variables – Univariate distribution functions – Expectations Univariate and Bivariate – Conditional expectations – Jointly distributed random variables – Independent random variables – Borel-Cantelli Lemma – Kolmogorov Zero – one law-Borel Theorem

Different types of Convergence of random variables – Almost sure, in law, in probability and in r th mean and their interrelations – Characteristic functions - Properties– Inversion formula, Bochner's theorem – Convergence distribution functions and characteristic functions – Convergence of moments – Helly compactness theorem, Helly-Bray theorem – Continuity theorem.

The law of large numbers – Weak law of large numbers – Tail Sigma Field - Kolmogorov strong law of large numbers – The Glivenco – Cantelli Theorem – Central limit theorems – Lindeberg–Levy theorem, Liapounov's theorem and Lindeberg – Feller theorems.

SURVIVAL ANALYSIS

Introduction to Survival analysis: Introduction-Definition-Censored data-Types. Functions of survival time: Definitions-Probability density function- Distribution function – Survival function-Hazard function-Cumulative hazard function-relationships of survival time.

Non-parametric methods: Product limit estimates-Life table Estimates-Relative-Corrected Survival rates-Standardized Rates and Ratios. Comparing Survival distributions: Two Survival distributions-Mantel-Haenszel test - Comparison of more than two samples.

Parametric methods and Estimation: Probability density function, Distribution function, Survival function and Hazard function of Exponential-Weibull-Lognormal-Gamma-Log-Logistic-Maximum Likelihood Estimation of Exponential-Weibull-Lognormal-Gamma-Log-Logistic.

Cox Proportional Hazards Model: Partial likelihood function-Significant Covariates-Adequacy Assessment of the proportional hazards model. Non-proportional hazards models: Time dependent covariates-Stratified proportional hazards models-competing Risks model-recurrent events models.

RESEARCH METHODOLOGY

An Introduction: Meaning of Research - Objectives of Research -Motivation in Research -Types of Research -Research Approaches -Significance of Research -Research Methods versus Methodology - Research and Scientific Method - Importance of Knowing How Research is Done - Research Process - Criteria of Good Research -Problems Encountered by Researchers in India .

Defining the Research Problem and design: What is a Research Problem -Selecting the Problem - Necessity of Defining the Problem -Technique Involved in Defining a Problem - An Illustration - Conclusion - Meaning of Research Design - Need for Research Design - Features of a Good Design - Important Concepts Relating to Research Design- Different Research Designs -Basic Principles of Experimental Designs - Conclusion - Developing a Research Plan.

Measurement and Scaling Techniques: Measurement in Research -Measurement Scales -Sources of Error in Measurement -Tests of Sound Measurement - Technique of Developing Measurement Tools -Scaling - Meaning of Scaling -Scale Classification Bases -Important Scaling Techniques -Scale Construction Techniques.

Sampling Fundamentals: Need for Sampling - Some Fundamental Definitions -Important Sampling Distributions -Central Limit Theorem -Sampling Theory -Sandler's A-test -Concept of Standard Error - Estimation -Estimating the Population Mean -Estimating Population Proportion -Sample Size and its Determination -Determination of Sample Size through the Approach -Based on Precision Rate and Confidence Level -Determination of Sample Size through the Approach- Based on Bayesian Statistics.

Interpretation and Report Writing: Meaning of Interpretation - Why Interpretation?-Technique of Interpretation: Precaution in Interpretation -Significance of Report Writing -Different Steps in Writing Report -Layout of the Research Report -Types of Reports -Oral Presentation - Mechanics of Writing a Research Report -Precautions for Writing Research Reports –Conclusions.

TESTING STATISTICAL HYPOTHESES

Unbiasedness for hypothesis testing, Uniformly most powerful unbiased tests, Unbiased tests for one parameter exponential family, Similar regions and complete sufficient statistics, Tests with Neymann Structure, Uniformly most powerful similar tests, Locally most powerful tests.

Invariant tests – maximal invariance, uniformly most powerful invariant tests, Likelihood Ratio test, Consistent tests.

One sample non-parametric tests – Kolmogorov–Smirnov test, Sign test, Wilcoxon Signed Rank test, Test for randomness, Two sample non-parametric tests, Kolmogorov Smirnov test, Wald-Wolfowitz run test, Mann-Whitney U test, Median test. K-sample test – Kurskal-Wallis test, Friedman test.

Sequential test – Basic Structure of Sequential tests – Sequential Probability Ratio Test (SPRT). Power and expected sample size of SPRT. Optimum properties of SPRT.

STOCHASTIC PROCESSES

Definition of Stochastic process – Specification of Stochastic Processes. Stationary Processes – Second order process, Stationarity, Gaussian processes. Martingales: Definition and properties,. Martingales in discrete time - Supermartingales and submartingales - Continuous Parameter Martingales- Martingale convergence theorem and its applications

Markov chains – Definitions and examples. Higher transition probabilities: Chapman – Kolmogrov equation. Classification of States and Chains – Determination of Higher Transition Probabilities -Aperiodic Chain: Limiting Behaviour. Stability of a Markov system.

Poisson process – Poisson process and related distributions. Pure Birth Process - Birth and Death process – Simple examples. Branching process – properties of generating function of branching process – Probability of extinction.

ADMINISTRATIVE OFFICER