Office of the Dean
FACULTY OF ENGINEERING & TECHNOLOGY
Jamia Millia Islamia, New Delhi-110025

Ph.D. ENTRANCE SYLLABUS
PAPER–I

General awareness related to engineering issues and their green solution, role of engineers on socio-economic building of society, reasoning on common engineering problems, comprehension, technical language, writing and analytical skills, contemporary issues relevant to research and higher education, introduction to basic research concepts, qualitative and quantitative research methods and statistics, research hypotheses, interpretation of data, variance, co-variance, random variables and probability, design of experiments, computer and information technology – its role in research.

(Professor Kafeel Ahmad)
Dy. Director-Research

(Professor M.N. Doja)
VC's Nominee

(Professor Mehtab Alam) 21/9/2011
Dean, F/o Engg. & Tech.

SYLLABUS
Ph.D. ENTRANCE TEST-2021-22

MECHANICAL ENGINEERING DEPARTMENT
JAMIA MILLA ISLAMIA
NEW DELHI

NOTE: This syllabus consists of the following TWO parts:

1. **PART B1 is objective type which carries 50 marks and it is common to all THREE**

   Stream i.e. Machine Design, Production and Industrial Engineering and Thermal Engineering.

2. **PART B2 is subjective type which also carries 50 marks and it is only for specific stream.**
   i.e. Machine Design, Production and Industrial Engineering and Thermal Engineering.

Machine Design:
Engineering Mechanics: Free body diagrams and equilibrium; kinematics and dynamics of particles and of rigid bodies in plane motion; impact.

Mechanics of Solids: Stress and strain, force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; springs; thin walled sections; Euler's theory of columns; strain energy methods; thermal stresses; mechanical properties; material testing.

Theory of Machines: Kinematics and dynamics of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels; bearings; governors; static & dynamic balancing of rotors.

Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance; critical speeds of shafts.

Design: Design for static and dynamic loading; failure theories; principles of the design of machine elements such as shafts, spur gears, rolling and sliding contact bearings, brakes, clutches and various joints.

Production and Industrial Engineering:
Production Engineering: Engineering Material, Conventional and Non-conventional Machining Processes, Computer controlled machines, CAD/CAM, CNC, Mechanics of Metal Cutting, Tool wear and Machinability, Economics of Metal cutting, Metal Forming, Casting Processes, Powder Metallurgy, Joining Processes, Measurement, Metrology and Inspection.

Industrial Engineering: Production systems, Systems approach, Productivity, Product design and development, Production Planning and Control, Statistical Quality Control, Operations Scheduling, Linear Optimization Models, Assignment and Transportation Models, Queuing Theory, Ergonomics, Inventory Control, Demand and Supply, Future worth and annual work for discrete cash flow and discrete compounding, Depreciation.

Thermal Engineering:

Thermodynamics:- Laws of thermodynamics, Entropy, Irreversibility and availability, calculation of heat and work, thermodynamic cycles, nozzles and Turbine.

Heat Transfer: Modes of heat transfer, Resistance concept, Unsteady heat conduction, Fins, Radiative heat transfer, black and grey surfaces shape factors, network analysis, Heat exchangers.

I.C. Engines: Requirements and suitability of fuels in IC engines, Normal and abnormal combustion in SI and CI engines, Engine performance calculations, Turbo-charging, Supercharging, Pollutant formation and control methods, Stratified charge engines, Homogenous charge compression ignition (HCCI) engines, Zero emission vehicles.

Refrigeration and air-conditioning: Refrigeration system, expansion devices, condensers and evaporators, Psychometric chart, Vapor Absorption system, Humidification, Dehumidification, Adiabatic mixing, Multi-staging, multi evaporation system, Solar refrigeration system.

Energy Conversion System: Basic cycles related to energy conversion systems, Combined cycle, Cogeneration system, Steam generator, Steam turbine, Gas turbines, Nuclear power plant, Hydroelectric plant.

Non-Conventional Energy Sources: Solar energy system, Solar power plant, Wind, Tidal, Wave and Geothermal energy, Energy from Biomass and Bio-fuels.

Fluid Mechanics:- Fluid properties, control volume analysis of mass, momentum and energy, equation of continuity, Bernoulli's equation, Boundary Layer Theory, flow through pipes, laminar and Turbulent flow and compressible. Hydraulic turbines, Centrifugal pumps, Pelton, Francis, Kaplan, Cavitations in pump and turbines, Performance curves.

Syllabus for PhD in Electronics & Communication Engineering Entrance Test 2021-22

Networks: Network Graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices, Solution methods: nodal and mesh analysis. Network theorems: Superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

Electronics Devices: Energy band diagrams in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-i-n and avalanche photo diode, Basics of LASERs. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin tub CMOS process.

Analog Circuits: Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers.
Amplifiers; single-and multi-stage, differential and operational, feedback, and power.
Frequency response of amplifiers. Simple op-amp circuits. Filters.
Oscillators: criterion for oscillation; single-transistor and op-amp configurations.
Function generators and wave shaping circuits, 555 Timers.
Power supplies.

Digital Circuits: Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers.
Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor (8085): architecture, programming, memory and I/O interfacing.

Signal and systems: Definitions and properties of Laplace transform, Fourier Series and Fourier transform. DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group dclay, phase delay. Signal transmission through LTI systems.

Control Systems: Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral- Derivative (PID) control.
State variable representation and solution of state equation of LTI control systems.

Basics of Communication Systems: Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication

systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR,) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Electromagnetics: Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting Vector. Plane Waves: Propagation through various media, reflection and refraction; phase and group velocity; skin depth.
Transmission lines: characteristics impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain.

Electronic Instrumentation: Units and dimensions, characteristics of Instruments. Analog concepts of measurement, Digital instruments. Intelligent Instruments, Biomedical Instruments, Sensors & Transducers.

Department of Civil Engineering
Faculty of Engineering & Technology
Jamia Millia Islamia, New Delhi

SYLLABUS FOR ENTRANCE TEST FOR Ph.D. IN CIVIL ENGINEERING

PART B

The examination for the PART B shall be of 100 marks and 2 hours duration.

This part shall consist of questions from the following specialized subjects of Civil Engineering as given below:

1. Structural Engineering
2. Water Resources Engineering
3. Environmental Engineering
4. Geotechnical Engineering
5. Transportation Engineering
6. Remote Sensing & GIS
7. Engineering Geology
8. Planning and Management Engineering

The candidate shall attempt only one subject related to his/her area of specialization in which he is interested to pursue research. Each subject will be divided into two sections (Section A and Section B).

Section A (Objective Type: 50 marks)
It shall comprise 50 multiple choice questions of 50 marks to test the knowledge of specialization of Civil Engineering at Master's Level.

Section B (Subjective Type: 50 marks)
It shall comprise eight descriptive type of questions of 10 marks each (out of which candidate is required to attempt five questions only) to test the advance knowledge of the concerned specialization of Civil Engineering at Master's Level.

The syllabus for each subject from Civil Engineering is given below:

1. Structural Engineering

Mechanics: Bending moments and shear forces in statically determinate beams - simple stress and strain: relationship - stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle - simple bending theory - flexural shear stress - thin-walled pressure vessels - uniform torsion.

Structural Analysis: Analysis of statically determinate trusses, arches and frames - displacements in statically determinate structures and analysis of statically indeterminate structures by force/energy methods - analysis by displacement methods (slope-deflection and moment-distribution methods) - influence lines for determinate and indeterminate structures - basic concepts of matrix methods of structural analysis.

Concrete Structures: Basic working stress and limit states design concepts - analysis of ultimate load capacity and design of members subject to flexure, shear, compression and torsion (beams, columns isolated footings) - basic elements of pre-stressed concrete: analysis of beam sections at transfer and service loads.

Steel Structures: Analysis and design of tension and compression members, beams and beam-columns, column bases - connections - simple and eccentric, beam-column connections, plate girders and trusses - plastic analysis of beams and frames.

Structural Dynamics: Formulation of equations of motion by different methods, single degree of freedom systems, free and forced response, effect of damping. Formulation of structure property matrices, Eigen values problems, Modes shapes and ortho-normality of modes, Approximate methods of extraction of Eigen values. Mode superposition techniques, Numerical integration procedures. Modeling - free and forced vibration of bars and beams. Idealisation of structures to mathematical models, examples of wind, earthquake and impact.

Theory of Elasticity and Plasticity: Analysis of stress and strain, stress strain relationship. Generalized Hooke's law. Plane stress and plane strain. Two dimensional problems in Cartesian and polar co-ordinates for simple problems. Torsion of non-circular section - methods of analysis - membrane analogy - torsion of thin rectangular section and hollow thin walled sections. Energy methods – principle of virtual work - energy theorem - Rayleigh Ritz methods - Finite Difference method.

Theory of Plates and Shells: Thin Plates with small defection. Laterally loaded thin plates, governing differential equation, various boundary conditions. Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's methods, Rectangular plates with various edge conditions. Symmetical bending of circular plates, plates on elastic foundation. Classification of shells - Types of shells - Structural action - Membrane theory - Shells of revolution and shells of translation - Examples - Limitations of membrane theory.

2. Water Resources Engineering

Principles of flow in hydro-systems, flow process and hydrostatic forces, fluid kinematics, energy and momentum equations, hydraulic processes – pressurized pipe flow, forces in pipe flow, laminar flow, boundary layer, drag and lift, turbulent flow, pipe flow systems, Energy and momentum principles in open channel, uniform flow, gradually varied flow, channel transitions,

spatially varied flow, unsteady flow, flow in mobile boundary channels, pollutants transport in open channels, flow measurements, fluid flow machines, hydraulic processes – groundwater flow, flow equations, well hydraulics, transient well hydraulics, hydrology – hydrologic system, rainfall, evaporation, infiltration, surface runoff, unit hydrographs, s-hydrograph, reservoir and stream flow routing, groundwater flow and pollution modeling; probability, risk and uncertainty analysis for hydrologic and hydraulic design, flood control, hydropower engineering, Water resources, irrigation engineering, regime theory, diversion, storage structures – weirs, barrages, dams, spillways, falls, outlets, etc. cross drainage works, reservoir operation, Water resources planning, system dynamics, systems engineering, water conflicts, river basin planning, systems reliability, case studies, system behavior and causal loop diagrams - systems thinking, EIA of water resources projects, Economic aspects of water resources development, Geographical Information Systems (GIS) and Remote Sensing in water resources engineering

3. Environmental Engineering

Water quality parameters; physical, chemical and microbiological, concepts of their evaluation and measurements, waterborne diseases, summary parameters for pollution control and potable water quality standards, water treatment unit operations and processes; screening, sedimentation, coagulation/flocculation, filtration, disinfection and distribution, water softening, ion exchange and mineralization for different uses.

Characteristics and composition of municipal sewage and different industrial wastewater, sampling and analysis techniques, standards for waste disposal, waste volume and strength reduction, equalization and proportioning of wastes, neutralization of wastes, general methods of treatment of industrial waste, preliminary treatment systems, flow measurement techniques, screening, grit removal and primary sedimentation, biological treatment, suspended and attached growth systems; activated sludge process and its modifications, trickling filter, bio- filters and rotating biological contractors, low cost systems, tertiary treatment, recycling and resources recovery.

Air pollution, major air pollutants and their effects on human, vegetation and other materials, global implications such as global warning, depletion of ozone layer, acid rain etc., air pollution meteorology, lapse rate, stability conditions, wind velocity profile, stack plumes, plume rise, Gaussian plume dispersion model, assumptions, application and limitations, air quality monitoring; sampling and analysis of major air pollutants, particulate and gaseous pollutants control.

Solid wastes and its classification, physical and chemical characteristics of municipal solid waste, municipal solid waste management, waste minimization, process modification, cost benefit analysis of waste minimization, material and energy recovery, solid waste treatment techniques and disposal, sanitary landfill.

4. Geotechnical Engineering

Soil Mechanics: Origin of Soil and Grain Size, Weight Volume Relationships, Plasticity and Soil Structure, Soil Classification, Compaction, Permeability, Seepage, In-situ Stresses, Stresses in Soil Mass, Compressibility, Shear Strength.

Foundation Engineering: Soil Exploration, Bearing Capacity of Foundations, Design of Spread Footing, Mat Foundation, Piles and Groups, Drilled Piers and Caissons, Lateral Earth Pressure and

Retaining Walls, Walls for Excavation, Slope Stability, Machine Foundation.

Ground Modification: Introduction to Engineering Ground Modifications, Mechanical Modification, Hydraulic Modification, Physical and Chemical Modification, Modifications by Inclusion and Confinement.

Geotechnical Earthquake Engineering: Seismology and Earthquakes, Strong Ground Motion, Wave Propagation, Dynamic Soil Properties, Liquefaction, Seismic Slope Stability, Seismic Design of Retaining Walls

5. Transportation Engineering

Highway Planning: Principles of Highway Planning, Road development plans, Privatisation of Highways, Transportation demand analysis – trip generation, trip distribution, modal split and traffic assignment.

Geometric Design: Cross section elements, design speed, sight distances requirements and design of horizontal and vertical alignments.

Traffic Engineering: Fundamentals of traffic flow, traffic stream models, traffic field studies and their uses, capacity and level of service, design of traffic facilities, traffic control devices, traffic management.

Pavement Design and Construction: Properties of subgrade and pavement component materials, tests on materials, bituminous mix design. Design factors, I.R.C. Design methods for flexible and concrete pavements, Pavement Construction Techniques and Quality control, Highway maintenance.

Traffic and Environment: Detrimental effect of traffic on environment, Air Pollution - Measures to reduce Air Pollution due to Traffic, Noise Pollution – Measures to reduce Noise Pollution.

Public Transportation: Urban transportation problem, planning for public transportation, route design, scheduling, management and operation of public transportation, sustainability and public transportation

6. Remote Sensing and GIS

Photogrammetry: introduction, geometric characteristics of aerial photograph; scale of a vertical and tilted photograph; determination of horizontal ground length from photo-coordinates; relief displacement; flight planning; image parallax and stereoscopy.

Remote Sensing: Principles and Basic concepts of Remote Sensing, Physics of remote sensing, effects of atmosphere. Spectral reflectance of earth's surface features in different wavelength region of electromagnetic spectrum: spectral characteristics of surface features (rocks, soils, vegetation, water). Image Enhancement; Image classification Procedures: Supervised, Unsupervised classification, Ground truth data and training Set manipulation, output data generation classification accuracy assessment.

Geographic Information System: Basics of Geographic information system (GIS), defining GIS, components; functions and advantages of GIS; data sources and transfer methods,

projections and coordinate systems, geo-referencing; Spatial data modelling: spatial, thematic and temporal dimensions of geographic data, spatial entity, spatial data models, spatial data structures, vector model vs. raster model of data structure; Attribute data management: concept of database and database management system, data models in GIS. Spatial analysis techniques such as overlay, extraction, and interpolation. Application of RS and GIS in Civil Engineering.

7. Engineering Geology

Applied Geology: Application of Engineering Geology in Civil Engineering Practices. Determination of sub surface strata characteristics using bore hole log method and geophysical method. Resistivity methods and application of Schlumberger and Wenner configuration for Identification of problematic issues in the sub surface strata. Remedial measures such as grouting etc. Sub surface investigations for mineral matters and rocks with ground improvement techniques

Petrology: Determination of engineering and physical properties of rocks. Identification and differentiation of aggregate materials of Sedimentary, Metamorphic and Igneous formation. Resource assessment of aggregate materials in the field. Rock weathering analysis and determination of fine aggregates. Deterministic approach for problematic sub surface zones. Determination and investigation of aggregates. Application of rocks as an aggregate material. Site investigation for course aggregates and fine aggregates. Application of aggregates in various civil engineering aspects including concrete and high ways. Application of petrological properties in civil engineering projects.

Hydrogeology: Hydrogeological applications for determination of aquifer materials. Analysis of ground water condition and behaviour with various aquifer system. Groundwater resource evaluation and aquifer improvement techniques. Artificial recharging system with their feasibility and design.

Geoengineering and Seismology: Engineering Geological operations and site investigation for Dam site and Reservoirs, Bridges and Highways, Tunnels and High rising buildings. Feasibility study for hard rock and soft rock tunnelling operations with problems and remediation. Seismic Zoning and determination of Earthquake zones based on lithology. Plate tectonic theory and Microzonation Analysis.

8. Planning and Management Engineering.

Introduction to construction project management: CPM, PERT, PDM, LOB, Scope management, WBS, Time and cost management, material related management – purchase & inventory control, time-cost-resource optimization, quality, safety – planning & control, Labor productivity variations, productivity improvement – work study. Measuring project progress & performance – EVA, Identification of risks and impact, Management information systems.

Construction Economics and Finance:

Engineering economics, Time value of money, discounted cash flow, NPV, ROR, Basis of comparison, Incremental rate of return, Benefit-cost analysis, Replacement analysis, Break even analysis, Depreciation, Taxation and inflation.

Construction Equipment:

Factors affecting selection of equipment – technical and economic, Analysis of production outputs and costs, Characteristics and performances of equipment for major civil engineering activities such as Earth moving, erection, material transport, pile driving, Dewatering and Concreting.

Construction Contract Management:

Professional Ethics, Duties and Responsibilities of Parties. Owner's and contractor's estimate, Bidding Models and Bidding Strategies, Qualification of Bidders. Tendering and Contractual procedures, Definition of Contract and its Applicability, Types of Contracts, Clauses in Domestic and International Contracts – CPWD, MES, FIDIC, etc.

Syllabus for Ph.D. Admission Test
Department of Computer Engg, Jamia Millia Islamia, New Delhi.

Engineering Mathematics

Discrete Mathematics: Sets, Relations, Functions, Groups, Lattice, Boolean algebra, Induction, Recurrence relations -- Combinatorics: Permutations, Combinations, Counting, Summation –

Elementary graph theory: Basic properties, Connectivity, Covering and matching, Planarity -- Elementary concepts of Linear and Matrix Algebra -- Numerical methods: Classical algorithms for interpolation and root finding.

Mathematical Logic: Propositional Logic, First-order Logic -- Probability: Random variables and expectation, Conditional probability, Independent random variables, Distributions (Uniform, Normal, Exponential, Poisson, Binomial)

Data Structure & Algorithm

Review of basic data structure, Dynamic data structure, Sorting algorithms with analysis, Tree algorithms, Graph algorithms. Computation complexity and asymptotic notations.

Database

Architecture of Database system, DB models, Operations on Relational model, Function dependencies & Normalization for relational databases, Concurrency control & recovery techniques, locking techniques, time stamp ordering, granularity of data items.

Operating System

Concept of O.S. , Classification of different O.S. Process and Interprocess communication, Deadlocks, Memory Management, I/O management, Threads, Protection & security.

Object oriented programming

Object oriented methodologies, Objects, classes, Inheritance, Polymorphism, Generic Programming concepts.

Advance Algorithms

Divide and conquer paradigm, Dynamic Programming, Greedy Algorithm, Randomized Algorithm, Geometric algorithms, Approximation algorithms, NP-Completeness, Polynomial time, Polynomial time verification, NP-completeness and reducibility, NP-Completeness proofs.

Computer Architecture

ALU and data path, CPU control design, Cache and main memory, Instruction pipeline, Control hazards and their solutions, Branch prediction, Bernstein's conditions, Instruction scheduling, Out of order execution, reservation stations. Arithmetic pipeline, Non-linear pipeline, Reservation table, multi function pipeline. Superscalar and VLIW processors.

Computer Network & Security

Network goals, classification, architecture, multi access protocol, Data link layer protocols, network routing, Flow and congestion control, Internet protocols, TCP, ATM, ABR, Quality of service in ATM, Network management – ASN, SNMP, and CMIP. Multicast – IGMP, PIM, DVMRP. Mobile IP.

Software Engineering

Software requirement analysis, Software design, software metrics, Software testing, Software maintenance

Theory of Computation & Compiler Design

Regular language and finite automata, context free languages and push down automata, Turing machine Lexical analysis, parsing, Syntax directed translation, run time environment, code generation, code optimization.

Department of Applied Sciences and Humanities
Faculty of Engineering and Technology,
Jamia Millia Islamia, New Delhi-110025

Entrance Syllabus, Ph.D. in Computer Science and Technology

Engineering Mathematics

Mathematical Logic: Propositional Logic; First Order Logic, Introduction to PROLOG.
Probability: Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions; Uniform, Normal, Exponential, Poisson, Binomial.
Set Theory & Algebra: Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra.
Combinatory: Permutations; Combinations; Counting; Summation; generating functions; recurrence relations; asymptotic.
Linear Algebra: Algebra of matrices, Determinants, Systems of linear equations, Eigen values and Eigen vectors, Consistency of a System of Linear Equations using Rank; Applications of Cayley- Hamilton Theorem.
Numerical Methods: LU Decomposition for Systems of Linear Equations, Gauss Elimination, Gauss Jordon and Gauss Seidal Methods; Numerical Solutions of Non-linear Algebraic and Transcendental Equations by Bisection, Regula-False Position, and Newton-Raphson Methods; Numerical Integration by Simpson's Rules, Bool's and Weddle's Rules, Romberg Integration Method and Numerical Double Integral; Numerical Solutions of a System of Differential Equations using RK Method, Picard's Methods, Milne Methods; Numerical Solutions of Boundary Value Problem using Finite Difference method and Cubic Spline Method.
Calculus: Limit, Continuity & differentiability, Mean value Theorems, Theorems of integral calculus, Evaluation of definite & improper integrals, Partial derivatives, Total derivatives, Maxima & Minima.

Programming in C and C++

Programming in C

Elements of C: Tokens, identifiers, data types in C. Control structures in C: Sequence, selection and iteration(s). Structured data types in C: Arrays, Structure, Union, String, and Pointers

Object Oriented Programming Concepts

Class, Object, Instantiation, Inheritance, Polymorphism and Overloading

C++ Programming

Elements of C++; Tokens, Identifiers, Variables and Constants, Data types, Operators, Control statements; Functions: Parameter Passing; Class and objects; Constructors and Destructors. Overloading, Inheritance, Templates, Exception Handling.

Data Structures and Algorithms

Data, Information, Definition of data structure; Arrays, Linked Lists, Stacks: Evaluation of Postfix, Prefix, and Infix Expressions; Queues: Circular Queue, Double Ended Queues and Priority Queues; Binary Trees: Binary Search Tree, B-trees; Tree Traversal Technique; Graphs

Theory: Connectivity; spanning trees; Cut vertices & Edges; Covering; Matching; independent sets; Coloring; Planarity; Isomorphism, Application(s) of Graph Theory in Software Engineering; Sorting and Searching Algorithms and their Comparative Study

Selected Topics of Computer Science

Digital logic, Introduction to Computer organization and Architecture; Theory of Computation; Different Phases of Compiler; Case study of UNIX and Linux Operating Systems; Computer Network: LAN, MAN, WAN, IP addressing, and Routing; Database Concepts: ER diagrams, Data Models, Design of Relational Database, Normalization- INF, 2NF, 3NF and 4NF; Limitations of 4NF and BCNF.

Software Engineering

Understanding of SDLC and Agile methods; Software Metrics: Function Point Approach, COCOMO etc; Software Project Management; Software Design, Software Reliability, and Software Maintenance; Requirements Engineering Processes: Requirements Elicitation, Requirements Modeling, Requirements Analysis, Requirements Verification and Validation, and Requirements Management; Introduction to different types of Testing
System design, detailed design. function oriented design, object oriented design, user interface design. Design level metrics

Data Base Management Systems and SQL

Database Concepts. ER diagams, Data Models, Design of Relational Database.
Normalisation- INF, 2NF, 3NF and 4NF. Limitations of 4NF and BCNF.
SQL-Data definition language(DDL), Data manipulation language(DML), Data control language (DCL) commands. Database objects like- Views, indexes, sequences, synonyms, data dictionary.
File structures: Sequential files, indexing, B and B+ trees), Transactions and concurrency control.
QBE, Query Processing and Optimisation, Centralised and Distributed Database, Security, Concurrency and Recovery in Centralised and Distributed Database Systems, Object Oriented Database Management Systems (Concepts, Composite objects. Integration with RDBMS applications), ORACLE.

Computer Graphics & Multimedia

Display systems, Input devices, 2D Geometry, Graphic operations, 3D Graphics, Animation, Graphic standard, Applications; Concepts, Storage Devices, Input Tools, Authoring Tools, Application Files.

II: Syllabus for Ph.D Admission in Applied Physics

1. **Classical Mechanics**
   Lagrangian and Hamiltonian Mechanics, Hamilton Jacoby theory, Actions angle variables.

2. **Mathematical Physics**
   Complex variables, Ordinary differential equations, finite group theory, calculus of variations, special functions of Physics.

3. **Quantum Mechanics**
   Schrodinger Equation, Bound States, Scattering, Perturbation theory, WKB approximations.

4. **Solid State**
   Free electron theory, Maxwell distribution, Fermi distribution, Bose Einstein distribution, Solid state devices.

5. **Relativity**
   Lorentz transformations, relativistic momentum and energy, electromagnetic field transformations.

6. **Electromagnetic theory**
   Maxwell's equations, Semi classical theory of radiation, Lasers and their applications.

7. **Frontiers of Physics**
   Big bang model of the universe, Basics of nanophysics, fibre optics.

V: Syllabus for Ph.D. Admission Test in Applied Psychology

Unit I: Academic satisfaction, course curriculum, academic performance and the related socio-economic factors, job performance and job involvement –the related socio-psychological (or organizational) factors.

Unit II: Work and fatigue & the related socio-personal factors.

Unit III: Industrial accidents: causes and the related safety & preventive measures.

Unit IV: Job Stress; & Job burnout, stress management and cooping strategies---the related socio economic and personal reasons.

Unit V: Industrial unrest, Strikes & lock outs and the related socio-economic & political reasons.

The questions for the aforesaid test may be set from any of the above section / sections.

III: Syllabus for Ph.D Admission in Applied Chemistry

Unit-1 Pollution & its control

Introduction, Environmental segments- lithosphere, hydrosphere, biosphere, atmosphere.

Radiation balance of the earth. Lapse rate & temperature inversion. Air pollution- Introduction, classification, air pollution & their effects, control of air pollution.

Water pollution- Introduction, water pollutants- oxygen demanding wastes, pathogens, nutrients, salts, thermal pollution, heavy metals, pesticides, volatile organic compounds; characterization of wastewater, methods & equipments used in wastewater treatment.

Soil & land pollution. Trace elements- pollution & control.

Unit-2 Corrosion & its control

Introduction, dry or chemical corrosion, wet or electrochemical corrosion, mechanism of wet corrosion, galvanic corrosion, concentration cell corrosion, passivity, pitting corrosion, intergranular corrosion, waterline corrosion, stress corrosion, galvanic series, factors influencing corrosion, corrosion control (protection against corrosion)

Unit-3 Optical Methods of Measurements

Spectrometery: Principles of electromagnetic radiation with matter, electronic adsorption spectra, molecular structure, IR and molecular structure, U.V. Atomic spectroscopic methods: Flame emission and atomic adsorption spectroscopy, X-ray diffraction methods of analysis.

Unit-4 Modern methods of separation

Solvent extraction: principles, solvent extraction of metals, analytical separation, multiple extractions. Chromatographic methods: Principles, technique of column chromatography, molecular extraction, ion-exchange, HPLC, TLC and paper chromatography, electrophoresis, supercritical fluid chromatography.

Unit-5 Thermal analysis

Methods of differential thermal analysis (DTA), differential scanning calorimetery (DSC) and thermo gravimetric analysis (TGA), Thermomechanical Analysis (TMA) and Dynamic Mechanical Analysis (DMA), Pyrolysis-gas Chromatography

PART D: Syllabus for Ph.D. Admission Test in Applied Mathematics

UNIT I: Applications of Laplace transforms and I.L.T. in the particular solution of integral equations, integro-differential equations and differential equations with variable coefficients, Z-transforms, inverse Z-transforms and its applications in the solution of linear difference equations, Use of DeMoivre's theorem, Ferrari / Descarte method, Cardan's method, reciprocal-equation method in the general solution of higher order ordinary linear differential equations with constant and variable coefficients, Use of Euler-Poisson equations in Calculus of variations (i.e. extremals of the functionals), Isoperimetric problems and Approximate solution of boundary value problems using Rayleigh-Ritz method.

UNIT II: Infinite Fourier transforms, infinite Fourier sine and cosine transforms and its applications, Product solutions of Laplace equations, heat conduction equations, wave equations, Poisson's equations by the method of separation of variables and their applications in boundary value problems, General solution of homogeneous and non-homogenepus linear partial differential equations of higher order with constant and variable coefficients. Gauss hypergeometric function, its transformations (linear and quadratic) and convergence, Fourier-Legendre series, Fourier-Bessel series, solution of Laguerre, Hermite and Jacobi differential equations and transformations of Bessel's differential equations.

UNIT III: Envelope of a family of curves, Evolute of a curve, Problems on Tensor analysis, Properties of eigen values of square matrices of order 4,5 and 6, Complex matrices and Quadratic forms, Numerical solution of boundary value problems using finite difference, cubic spline and shooting methods, Numerical solution of heat conduction equations, Poisson, Laplace and Wave equations; Geometrical representation of $W = f(z)$, Conformal mapping, Bilinear transformations, evaluation of real definite integral using calculus of residue. Applications of Gamma and Beta functions in multipule integrals (Dirichlet's and Liouville's integrals).

UNIT IV: Interpolation, Aitken and Aitken-Neville methods, Missing-terms problems, Hermite Interpolation, Fitting of a curve in given sub-interval using cubic spline interpolation, Representation of a tabulated function in powers of (x-a) using Newton's divided difference formula, Applications of numerical successive differentiation in practical problems and double interpolation. Generating functions, Recurrence relations, integral representations and orthogonal properties of Bessel's function $Jn(x)$ and Legendre Polynomial $Pn(x)$.

UNIT V: Numerical integration using Romberg method, Gauss-Legendre and Lobatto methods, Gaussian integration and numerical double integration, Conversion of a differential equation into integral equation & vice versa, Solutions of Fredholm and Volterra integral equations of first and second kinds, Numerical solution of a system of non-linear equations using Newton-Raphson method, Solution of system of linear equations in four variables using Gauss-Jordan and Crout's methods.

ANNEXURE – III

SYLLABUS FOR PH.D ADMISSION IN DEPTT. APPLIED SCIENCES & HUMANITIES

I : Syllabus For Entrance Test for Ph.D Admission in Electronic Science

Analog Electronics

Different types of Amplifiers, Characteristics & Definitions OP-amps, Differential Amplifiers, Common Mode Gain, Differential Mode Gain, CMRR, Applications of OP-amps, The 555 Timer, Operational Modes, Time Delay, Astable and Monostable Operations, Basic Criteria of oscillation, Wein-Bridge Oscillator, RC phase Shift Oscillator.

Solid State Electronics

Energy band, Direct & indirect semiconductor , Electron and hole, effective mass, intrinsic & extrinsic material, Electron and holes in quantum Well; Effect of Temperature and pressure on band gap. semiconductor statistics: Energy distribution functions, Density of states function for 3D, 2D and 1D structure.
Carrier Concentration for intrinsic and extrinsic semiconductor, compensation in semiconductor, Doping of excess carriers, Consequences of heavy doping. conduction processes in semiconductors under high electric magnetic fields.

Electromagnetics

Wave equations, Plane Wave propagation, polarizations, plane wave in perfect dielectrics and imperfect dielectric & conductors, reflection of plane waves normally incident on discontinuities: perfect conductor, transmission line analogy of wave propagation, the impedance concept, dielectrics; reflection of plane waves Obliquely incident on Discontinuities: perfect conductor, Dielectrics, Snell's law of reflections, Total internal reflections.

Signals and Systems

Continuous and Discrete Time Signals, Types of Signals, Operation on Signals, Continuous Time & Discrete Time Convolutions, Linear Time Invariant Systems, Stability of Systems, Fourier Series, Continuous & Discrete Time Fourier Transform, Laplace Transform, Z-transform

Microprocessors

Review of Digital Components & Circuits, Magnetic Memories, Magnetic Tape, Drum & Disc Memories. Semiconductor Memories, RAM, ROM, PROM, EPROM, Architecture of 8085A microprocessor, timing diagrams for 8085A. Introduction sets of microprocessor 8085A, Addressing modes and status flags.

Electronic Devices

BJT Structure, BJT in Active Mode, BJT Configuration and Small Signal Parameters, Frequency Response, Heterojunction BJT, Ebers-Moll Model, SCR, JFET & MESFET, Signal Transfer, Gain, Small Signal Linear Equivalent Circuits, MOSFET, C-MOS & CCD, MOSFET Structure, MOS Capacitor Band Diagrams, MOSFET I-V Characteristics, MOSFET Small Signal Equivalent Circuits.

Syllabus: Doctor of Philosophy in English
Department of Applied Sciences and Humanities
Faculty of Engineering and Technology
Jamia Millia Islamia
New Delhi-110025

Unit-I: British literature

History of British Literature from Chaucer to present Age, origin and development of literary genres, canonical and representative works of different literary movements, socio-political movements that shaped the distinct literary fervor and traits.

Unit-II: Indian writings in English

Chronological development of Indian writing in English, Post-Independence Indian English poetry, Indian English Fiction with special emphasis on fiction women novelists & Indian English Drama

Unit III Literary Terms, Criticism and Theory

Literary terms: Literary devices, genres & movements
Literary Criticism: Plato, Aristotle, Longinus, Dryden, Wordsworth, Coleridge, Arnold, I. A. Richards, T.S. Eliot.
Contemporary Literary Theory: Marxism, psychoanalytical criticism, Archetypical criticism, Russian Formalism, Structuralism, Post- structuralism, American Deconstruction, Feminism, Post-colonialism, Narratology, Reader response theory, New Historicism, Cultural Materialism & Queer theory

Unit IV Linguistics

Characteristics of human verbal communication and barriers, English Syntax, Phonology, International Phonetic Alphabets, Accent, Intonation, Stylistics, word formation, sociolinguistics, Psycholinguistics, Methods of English Language Teaching, English for special purpose & Translation theory

Unit V: New literatures in English

Salman Rushdee, Bharati Mukherjee, V.S. Naipaul, Jhumpa Lahiri, Bapsi Sidhwa, Arvind Adiga, Kiran Desai
Patrick White, A.D.Hope & Judith Wright
Margret Atwood, E.J Pratt & A.J.M. Smith
Frantz Fanon, Chinua Achebe, N'Gugi, Nadine Gordimer, Alice Walker
Wilson Harris, George Lamming & Derek Walcott

PROFORMA

DETAILS OF ENTRANCE TEST-2021-2022

Name of the Faculty:	**Faculty of Engineering and Technology**
Department/Centre:	**Department of Electrical Engineering**
Name of the Program:	**Ph. D. in Electrical Engineering**
About Program's Prospects: --	
Summary of Entrance Test:	**For Paper II of Ph.D. Entrance Test**

There are total VIII (8) research groups, out of which Group I to V is under Electrical Technology Research Group and Group VI to VIII is under Digital Health Technology Research Group.

A student must choose any one group out of VIII in the entrance form. The corresponding exam test paper will be provided to student for the chosen group.

Detailed Syllabus for the Entrance Test

Syllabus for Paper II of Ph.D. Entrance Test:

Group-I: POWER SYSTEM

Transmission line parameters; Representation of short, medium, and long transmission lines – ABCD parameters; Circle Diagram; Per Unit representation; 3-Φ system; Short Circuit Studies; Sequence Networks; Load-flow Studies – Gauss Seidel method, Newton-Raphson Method; Automatic Generation Control; Load-Frequency Control; Automatic Voltage Regulator; Power System Stability – Equal area criteria; Swing Equation; Optimal Load dispatch in Power System. Protection Schemes for Transformer, Generators and Transmission Lines.

Group-II: POWER ELECTRONICS AND ELECTRIC MACHINES

Characteristics and ratings of different power electronics devices, their turn on and turn off methods with their protection. Controlled and uncontrolled single and three phase AC-DC Converters with R, R-L, R-L-E load. Controlled and uncontrolled single and three phase DC-AC Converters with R, R-L load. DC-DC converters and AC-AC converters and its control. Power

Electronics Converters and its control for Solar, Wind and other renewable energy sources. Power Electronics Converters for HVDC, FACTS, Electric drives application, and Stability analysis of Power Electronics Converters.
Transformers: single & three phase; Construction, operation, performance calculations, Induction machines: single & three phase; Construction, operation, performance calculations & control, Three-phase Synchronous machines: Construction, operation, performance calculations & control, DC machines: Construction, operation, performance calculations & control

Group-III: CONTROL AND INSTRUMENTATION

Mathematical Modelling of physical systems, Transfer function of linear systems, Steady state errors and error constants, static error coefficients Time domain analysis, Stability of control system, Routh-Hurwitz's stability criterion. Root locus plots, analysis of control system by root loci. Relationship between time and frequency response, Polar plot, Bode's Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins, Constant M and N circle. Design of Feedback Controllers: Design of Proportional, Integral, Derivative, PI, PID controllers of first, second order systems. Control loop with auxiliary feedback, Feed forward control, Practical Controller tuning tips, Ziegler-Nichol's tuning methods. Compensation design using Bode Diagram and Root Locus technique, Reshaping the Root Locus, Cascade Lag, Lead and Lag-Lead compensators. Sate Variable concepts, State model, State transition matrix, conversion of state-variable modes to transfer functions, conversion of transfer function to canonical state-variable models, solution of state equation, concepts of controllability and observability. Stability Improvement by state feedback, Necessary and sufficient conditions for arbitrary pole placement, State regulator theory, design of state observer, Servo design: Introduction of reference input by feed forward control. Recent advances in control system design technologies. Classification of Instruments, Moving iron, Moving Coil, Permanent magnet, and Dynamometer types. Thermal, Electrostatic Rectifier Instruments, transforms, CT, PT, Power measuring instruments, power factor, frequency meters and synchroscope. Measurement of low, medium and high resistances AC and DC measuring bridges, Magnetic measurement. General Transducers voltage, currant, phase angle, optical, Hall effect and Industrial transducers Electronic voltmeters, Vacuum Tube Voltmeter (VTVM), data acquisition system, spectrum analyses, sensors Measuring or sensing devising in different application, Generalized performance characteristics of the measuring instruments. Physical and chemical sensors, Principle of working of physical and chemical sensors, interface electronics circuits for instruments/sensor for data manipulation, transmission and recording Computer aided measurement of voltage current power energy frequency phase angle. High voltage measurement.

Group-IV: ELECTRONICS AND COMMUNICATION

Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single-and multistage, differential and operational, feedback, and power. Frequency response of amplifiers. Simple op-amp circuits. Filters. Function generators and wave-shaping circuits, 555 Timers. Power supplies. Logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Operational Amplifiers and other analog ICs., Semiconductor memories. Microprocessor(8085): architecture, programming and I/O interfacing. Amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers. Signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK,

PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Group-V: COMPUTER SCIENCE AND TECHNOLOGY

Soft Computing: Artificial neural network, fuzzy logic, genetic algorithm; Digital Electronics: Boolean algebra, Combinational and Sequential Circuit, Number representation & Computer Arithmetic; Computer Organization & Architecture: Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode); Data Structures: arrays, linked list, graphs, queue, stacks, Searching, sorting, hashing. Asymptotic worst-case time and space complexity, Algorithm design techniques: greedy, dynamic programming and divide and conquer. Graph search, minimum spanning trees, and shortest paths; Object Oriented programming: classes and objects, inheritance, polymorphism; Operating Systems: Operating System Structure, management of resources Processes, threads, inter-process communication, concurrency and synchronization, Deadlock, CPU scheduling, Memory management and virtual memory. File systems; Data Communication and Networks: Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Group-VI: BIOMEDICAL ENGINEERING

Electrical Circuits, Signals and Systems, Analog and Digital Electronics, Sensors - resistive, capacitive, inductive, piezoelectric, Hall effect, electro chemical, optical; Sensor signal conditioning circuits; application of LASER in sensing and therapy. Origin of biopotentials and their measurement techniques-ECG, EEG, EMG, ERG, EOG, GSR, PCG, Principles of measuring blood pressure, body temperature, volume and flow in arteries, veins and tissues, respiratory measurements and cardiac output measurement. Medical equipment: sphygmomanometer, ventilator, cardiac pacemaker, defibrillator, pulse oximeter, hemodialyzer; Electrical Isolation and Safety of Biomedical Instruments. Instrumentation and image formation techniques in medical imaging modalities such as X-Ray, Computed Tomography, Magnetic Resonance Imaging, Ultrasound,

Group-VII: DENTAL SCIENCES AND TECHNOLOGY

Fundamentals of biomedical devices, Dental Anatomy, Anatomy of Head and Neck, Dental Materials, Oral Medicine and Radiology, Oral and Maxillofacial Surgery, Periodontics, Prosthodontics including Crown and Bridge and Implantology, Conservative Dentistry, Orthodontics, Pedodontics and Children's Preventive Dentistry, Oral Pathology and Microbiology, Oral Biology Community, Social and Preventive Dentistry, Public Health Dentistry.

Group-VIII: MEDICAL SCIENCES AND TECHNOLOGY

Fundamentals of biomedical devices, human anatomy, human physiology including bio-physics, biochemistry, basics of cell, types of tissues and organ systems; homeostasis; basics of organ systems: musculoskeletal, respiratory, circulatory, excretory, endocrine, nervous, gastro-intestinal and reproductive, introduction to humanities & community medicine, forensic medicine including toxicology, dermatology and sexually transmitted diseases, orthopaedics, radiotherapy, ophthalmology, obstetrics and gynaecology, obstetrics and gynaecology, general medicine, general surgery, paediatrics, ear, nose, and throat, psychiatry, anaesthesiology.

s/d
(Prof. Munna Khan)
Head