CHAPTER - 3: Details pertaining to GGSIPU CET (Common Entrance Tests)

3.1 Graduation Programmes (Engineering) Common Entrance Tests

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
1.	LEBTECH (DIPLOMA)	128	i. Applied Mechanics-(25) ii. Applied Mathematics-(25%) iii. Computer Awareness and Physics / Chemistry Related Knowledge-(25%) iv. Analytical and Logical Reasoning-(25%)
2.	LEBTECH (BSC)	129	i. B.Sc Level Mathematics- (40%) ii. English (10+2 level)-(20%) iii. Analytical & Logical Reasoning (20%) iv. Scientific Aptitude - (20%)
3.	BTECH(BT)	130	i. Physics (upto 12th Level)-(20%) ii. Chemistry (upto 12th Level)-(20%) iii. Mathematics(upto 12th Level)-(20%) iv. Biology (Botany and Zoology) (upto 12th Level)– (40%) or Biotechnology (upto 12th Level)-(40%)
4.	BTECH	131	All applicants are required to appear for Joint Entrance Exam (JEE) Main Paper 1 Conducted by National Testing Agency (NTA). The University shall not conduct its own CET for admissions, but shall be utilizing the merit of JEE Main Paper 1 for its admissions.

NOTE:
*Syllabi for CET Code 128, for the prescribed subjects shall be as of upto Diploma or 10+2 level. Syllabi for CET Code 130, for the subjects of Physics, Chemistry, Mathematics, Biology (Botany & Zoology) or Biotechnology shall be upto 12th class under the 10+2 Scheme unless specified otherwise.

3.2 Master of Technology (M.Tech.) Common Entrance Test

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
1.	MTECH (CS)	139	As per the Syllabus of GATE -Computer Science and Information Technology
2.	MTECH (EC)	140	As per the Syllabus of GATE -Electronics & Communication Engineering
3.	MTECH (BT)	148	See Section 3.2.1
4.	MTECH (CE)	152	As per Syllabus of GATE of Chemical Engineering
5.	MTECH (RA)	156	See Section 3.2.2

3.2.1 Syllabus for CET for M.Tech. (Biotechnology) CET Code-148

Biochemistry and Enzymology: Organization of life; Importance of water; Structure and function of biomolecules: Amino acids, Carbohydrates, Lipids, Proteins and Nucleic acids; Protein structure, folding and function,Metabolic pathways and their regulation: glycolysis, TCA cycle (Krebs' cycle), glycolysis, electron transport chain; gluconeogenesis, glycogen and fatty acid metabolism, Enzyme classification, kinetics including its regulation and inhibition, active sites, Factors influencing enzyme activity, Enzyme assays, cofactors and coenzymes, immobilization of enzymes, enzyme engineering.

Microbiology: Size, shape and arrangement of bacterial cells, Structure of the cell and cell wallNutritional requirements for growth, nutrients uptake by microbial cells, Culture media, Isolation of pure cultures, cultivation and preservation of cultures, Microbial growth Kinetics, Physical and chemical methods of microbial control, Action of microbial control agents and evaluation of effectiveness of antimicrobial

agents, Metabolic diversity and pathways of energy use, unique pathways of microbial fermentation and photosynthesis, Microbial diseases and their control, Mechanism of microbial pathogenicity, action of antibiotics and other antimicrobial drugs, Superbugs and opportunistic infections, Biosecurity, Microbiome.

Cell Biology: Cell structure and organelles; Biological membranes; Transport across membranes; Signal transduction; Hormones and neurotransmitters.Prokaryotic and eukaryotic cell structure**;** Cell cycle, cell division and cell growth control**;** Cell-Cell communication, Cell signaling and signal transduction.

Molecular Biology and Genetics: Molecular structure of genes and chromosomes; Mutations and mutagenesis; Eukaryotic genome organization and Complexity; Nucleic acid replication, transcription, translation in prokaryotes and eukaryotes; RNA processing, regulation of gene expression, Mendelian inheritance; organization of genome, sex determination and sex-linked characteristics, cytoplasmic inheritance, linkage, recombination and mapping of genes in eukaryotes, population genetics. Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extra chromosomal inheritance; Microbial genetics (plasmids, transformation, transduction, conjugation); Epigenetics.

Immunology: Active and passive immunity; Innate, humoral and cell mediated immunity; Antigen; Antibody structure and function; Molecular basis of antibody diversity; Synthesis of antibody and secretion; Antigen-antibody reaction; Complement; Primary and secondary lymphoid organ; B and T cells and macrophages; Major histocompatibility complex (MHC); T cell receptor; Antigen processing and presentation; Polyclonal and monoclonal antibody; Regulation of immune response; Immune tolerance; Hypersensitivity; Autoimmunity; Graft versus host reaction. Immunological techniques: Immunodiffusion, immunoelectrophoresis, RIA and ELISA, Flow cytometry.

Bioinformatics: Major bioinformatic resources and search tools; Sequence and structure databases**;** Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny).

Recombinant DNA Technology: Restriction and modification enzymes; Vectors-plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; mammalian and plant expression vectors; cDNA and genomic DNA library; Gene isolation, cloning and expression; Transposons and gene targeting; DNA labeling; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD, RFLP, AFLP, SSRs, SNPs; Gene transfer techniques; Microarray, PCR, site directed mutagenesis, DNA sequencing; molecular probes, Gene therapy.

Plant and Animal Biotechnology: Totipotency; Regeneration of plants; Tissue culture and Cell suspension culture system; Production of secondary metabolites by plant suspension cultures; transgenic plants; Plant products of industrial importance; Animal cell culture, media composition and growth conditions; Animal cell and tissue preservation; Anchorage and non-anchorage dependent cell culture; Hybridoma technology; Stem cell technology; Animal cloning; Transgenic plants and animals.

Bioprocess Engineering and Process Biotechnology: Upstream production and downstream; Bioprocess design and development from lab to industrial scale; Microbial, animal and plant cell culture platforms, Chemical engineering principles applied to biological system, Principle of reactor design, mass and heat transfer; Media formulation and optimization; Kinetics of microbial growth, substrate utilization and product formation; Sterilization of air and media; Batch, fed-batch and continuous processes; Various types of microbial and enzyme reactors.

Biosafety, Bioethical and Intellectual Property Right Issues in Biotechnology: Biosafety- Concept, Concerns and Regulations; Safety considerations in Laboratories; Ethical issues and conflicts in biotechnology; Kinds of IPR; Protection of traditional knowledge and Genetic Resources; Patents in Biotechnology.

Techniques in Biotechnology: Colorimetry and Spectroscopy, Flow cytometry, Microscopy, Centrifugation, Chromatography, Electrophoresis, X-ray crystallography, Nuclear Magnetic Resonance (NMR) spectra, Magnetic Resonance Imaging (MRI), lasers in biology and medicine, Mass spectrometry.

Environmental Biotechnology: Sewage and waste water treatment, Solid waste management, Biodegradation of xenobiotic compounds, Bioremediation and biorestoration, Natural resource recovery, Environmental biotechnology in agriculture, Biofuel, Environmental genetics.

Biostatistic: Measures of central tendency and dispersal; probability distributions (Binomial,Poisson and normal); Sampling distribution; Difference between parametric andnon-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; Chi squared test; Basic introduction to multivariate statistics, etc.

3.2.2 Syllabus for CET for M.Tech. (Robotics & Automation) CET Code-156

ENGINEERING MATHEMATICS

Mathematical Logic: Propositional Logic, First Order Logic.

Complex Variables: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent' series. Residue theorem, solution integrals.

Differential equations: First order equation (linear and non-linear), Higher order linear differential equations with constant coefficients, Methods of variation of parameters, Cauchy's and Euler's equations. Initial and boundary value problems, Partial Differential Equations and variable separable method.

Probability and Statistics:-Sampling theorems, Conditional probability, Mean, Median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distribution, Correlation and regression analysis.

Set Theory & Algebra:- Sets: Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra.

Combinatorics: Permutations; Combinations; Counting; Summation; generating functions; recurrence relations, asymptotics.

Graph Theory: Connectivity: spanning trees; Cut vertices & edges; covering; matching; independent sets; Colouring; Planarity; Isomorphism.

Linear Algebra:- Algebra of matrices, determinants, systems of linear equations, Eigen values and Eigen vectors.

Numerical Methods:- LU decomposition for systems of linear equations; numerical solutions of non-linear algebraic equations by Secant, Bisection and Newton- Raphson Methods; Numerical integration by trapezoidal and Simpson's rules.

Calculus:- Limit, Continuity & differentiability, Mean value Theorems, Theorems of Integral calculus, evaluation of definite & improper integrals, Partial derivatives, Total derivatives, maxima & minima,

Multiple integrals, Fourier series. Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

ENGINEERING SUBJECTS

Network theorems: Superposition, Thevenin and Norton's maximum power transfer.

Electric Circuits and Fields: Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks.

Programming in C, Functions.

Electrical Machines: Single phase transformer- equivalent circuit, phasor diagram , tests, regulations and efficiency, DC machines- types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors- principles, types, performances characteristics, starting and speed control; single phase induction motors; synchronous machines- performances, regulation and parallel operation of generators, motor starting, characteristics and application; servo and stepper motors.

Electronic Devices: Generation and recombination of carriers. P-n junction diode, Zener diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and available photo diode, Basics of LASERs. Device technology.
Basics of Measurement Systems:- Static and dynamic characteristics of Measurement Systems. Error and uncertainty, analysis, statistical analysis of data and curve fitting.
Transducers, Mechanical Measurement and Industrial Instrumentation: Resistive, Capacitive, Inductive and piezoelectric transducers and their signal conditioning. Measurement of displacement, velocity and acceleration (translational and rotational), force, torque, vibration and shock. Measurement of pressure, flow, temperature and liquid level. Measurement of pH, conductivity, viscosity and humidity.
Control System:- Principles of feedback, transfer function; block diagrams; steady- state errors, Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems.
Applied Mechanics:- Free body diagrams and equilibrium, trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations, impact, strength of materials- stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.
Theory of Machines: Acceleration of a point on a link, Acceleration diagram, Coroilis component of acceleration, Crank and slotted lever mechanism, Klien's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism, Mechanisms with Lower Pairs Pantograph, Exact straight line motion mechanisms- Peaucellier's Hart and Scott Russell mechanism, Approximate straight line motion mechanisms- Peaucellier's, Hart and Scott Rusell mechanism. Approximate straight line motion mechanism- Grass- Hopper, Watt and Tchebicheff mechanism, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms

3.3 Bachelor of Architecture (B. Arch.)

1. Applicants will have to fill their result of qualifying examination and NATA Score.
2. Display of Registered Candidate list on University's Website (www.ipu.ac.in) by CET CELL, GGSIPU.
3. Display of Schedule for verification of documents shall be notified later.
4. Authorized representative (with the permission of the Joint Registrar (Admissions), Guru Gobind Singh Indraprastha University) may appear for verification. In case, a candidate/representative does not appear for document verification, the candidature of such candidates will be cancelled and the candidates shall not be considered for admission.
5. Display of Final Merit List shall be notified later.

NOTE:

1. There shall be no CET for admissions to B.Arch. Programme. All candidates should have appeared in NATA 2022.

a. Professional Programmes

3.4.1 Postgraduate Programmes Common Entrance Tests

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
1.	MCA	105	i. Mathematics (25%) ii. English Language and Comprehension (25%) iii. Computer Awareness (25%) iv. Logical and Analytical Ability (25%)
2.	MA (MC)	106	i. Communication Skills- English (30%) ii. Current Affairs- (20%) iii. General Knowledge- (20%) iv. Mass Media (Print/ TV/ Radio/ Film/ New Media)- (30%)
3.	MPT	107	i. Anatomy

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
			ii. Biomechanics iii. Exercise iv. Electrotherapy v. Physiotherapy- Rehabilitation in Clinical Sciences vi. Musculoskeletal vii. Neurology
4.	MOT	108	i. Anatomy ii. Biomechanics iii. Exercise iv. Occupational Therapy in Mental Health v. Occupational Therapy in Rehabilitation of Neurological Conditions. vi. Occupational Therapy in Physical Dysfunction
5.	MPO	109	i. Anatomy ii. Biomechanics iii. Electrotherapy iv. Applied Mechanics and strength of materials v. Prosthetics vi. Orthotics
6.	M.Sc. (EM)	111	i. Environment Science- (50%) ii. Either Botany and Zoology- (50%) Or Physics, Chemistry, Geology and Mathematics- (50%)
7.	LL.M.	112	All applicants are required to appear in Common Law Admission Test – Postgraduate, 2022 (CLAT – PG, 2022) that is conducted by National Law University's on a rotational basis. The University shall not conduct its own CET for admissions, but shall be utilizing the merit prepared on the basis of (CLAT – PG, 2022) Merit for its admissions.
8.	MA (ENG)	113	i. English Language & Comprehension (30%) ii. General Awareness & Culture (10%) **iii.** Literature (60%)
9.	M.Ed.	120	i. Teaching Aptitude (20%) ii. Philosophical and Psychological Foundations of Education (20%) iii. Sociological and Historical & Political Foundations of Education (20%) iv. Language Proficiency (20%) v. General Awareness and Reasoning (20%)
10.	M.Sc. (B&C)	123	i. Life Sciences (Taxonomy, morphology, anatomy, physiology, genetics, evolution, ecology, bio-geography and economic uses of all the five kingdoms and virus) (50%) ii. Anthropology and Traditional Knowledge, Bio-cultural Knowledge (10%) iii. Biotechnology (20%) iv. General Knowledge related to Environment issues (20%)
11.	M.Sc. (NRM)	145	i. Environment Science – (30 %) ii. Biology- (40%) iii. General Knowledge – Physics, Chemistry, Geology, Biotechnology, Social Science, Economics & Policy- (30%)
12.	MA (ECO)	162	(i) Statistical & Mathematical Methods and Introductory Econometrics (30%) (ii) Economic Theory (Microeconomics, Macroeconomics, International Economics, Development Economics and Monetary Economics (70%)
13.	MSC (Y)	187	i. Anatomy – 50 questions ii. Physiology – 50 questions iii. General Awareness – 20 questions iv. General Science – 30 questions

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
14.	MSC (N)	198	B.Sc. (Nursing) level questions
15.	M.Sc. Medicinal Chemistry & Drug Design	405	1. Chemistry (Graduation Level) (70%) 2. Pharmaceutical Sciences (Graduation level) (30%)
16.	M.Sc. (Packaging Technology)	604	The syllabus for the written test is at the graduate level and the subjects include Physics, Chemistry Mathematics and Engineering. Please refer to para 3.4.4 for more details.
17.	M.Ed. Spl Education (Intellectual Disabilities)	612	i. Special Edu cation– 40% ii. Teaching Aptitude – 20% iii. Language Proficiency– 20% iv. General Awareness–20%

* The division of the number of questions in subparts of the syllabus is indicative.

NOTE:

1. Level of questions asked shall be as per the level of qualifying examinations for entry to the programme(s) of studies.

3.4.2 Graduation Programmes (Non-Engineering) Common Entrance Tests

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
1.	BCA	114	i. English Language & Comprehension (15%) ii. Mathematics – (30%) iii. Computer Awareness- (30%) iv. General Knowledge- IT and Science Related – (25%)
2.	BSC(Y)	117	i. Physics- 30 questions ii. Chemistry – 30 questions iii. Biology- 30 questions or biotechnology – 30 questions iv. Mathematics – 30 questions v. General Awareness – 15 questions vi. English Language & Comprehension – 15 questions
3.	Integrated B.A. LL.B. (Hons.) / Integrated B.B.A. LL.B. (Hons.)	121	All applicants are required to appear in Common Law Admission Test – Undergraduate, 2022 (CLAT – UG, 2022) that is conducted by National Law University's on a rotational basis. The University shall not conduct its own CET for admissions, but shall be utilizing the merit prepared on the basis of (CLAT – UG, 2022) Merit for its admissions.
4.	BED	122	i. Language Proficiency - 25% ii. Mental Ability and Reasoning - 25% iii. General Awareness – 25% iv. Aptitude for Teaching – 25% The Question Paper shall be set both in English and Hindi Language (Except the English Comprehension Section which shall only be in english).
5.	Bachelor of Physiotherapy (BPT)	124	i. Physics- (25%) ii. Chemistry – (25%) iii. Biology- (50%)
6.	Bachelor of Occupational Therapy (BOT)	124	i. Physics- (25%) ii. Chemistry – (25%) iii. Biology- (50%)
7.	Bachelor of Prosthetics & Orthotics (BPO)	124	i. Physics- (25%) ii. Chemistry – (25%) iii. Biology- (50%)
8.	Bachelor of Science in Medical Laboratory Technology {B.SC. (MLT)}	124	i. Physics- (25%) ii. Chemistry – (25%) iii. Biology- (50%)
9.	Bachelor of Audiology and Speech Language Pathology (BASLP)	124	i. Physics- (25%) ii. Chemistry – (25%) iii. Biology- (50%)
10.	BBA	125	i. English Language & Comprehension – (25%) ii. General Awareness- (25%) iii. Logical and Analytical Ability- (25%) iv. Aptitude relating to the field of Management and Communication Skills- (25%)
11.	BA (JMC)	126	i. English Language & Comprehension – (25%)

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
			ii. General Awareness- (25%) iii. Reasoning- (25%) iv. Media Aptitude- (25%)
12.	BHMCT	127	i. English Language & Comprehension – (25%) ii. General Awareness- (20%) iii. Logical and Analytical Ability including Computer awareness- (30%) iv. Knowledge of Accounts / Commerce & Science - (20%)
13.	BPHARMA	133	i. Biology – (25%) ii. Physics – (25%) iii. Chemistry – (25%) iv. English & General Awareness – (25%)
14.	B.Sc. (MIT)	134	i. Biology – (25%) ii. Physics – (25%) iii. Chemistry – (25%) iv. English & General Awareness – (25%)
15.	B.COM. (Hons)	146	i. General English – (25%) ii. Logical Reasoning- (25%) iii. Data Interpretation – (35%) iv. General Awareness- (15%)
16.	B.Sc. (MTR)	158	i. Biology – (25%) ii. Physics – (25%) iii. Chemistry – (25%) iv. English & General Awareness – (25%)
17.	BED (SPL EDU)	159	i. Language Proficiency- 25% ii. Mental Ability and Reasoning - 25% iii. General Awareness – 25% iv. Aptitude for Teaching – 25% This CET shall be conducted in English / Hindi Language.
18.	Bachelor of Arts (English (Hons)	184	i. General English (50%) ii. Literary Aptitude (30%) iii. General Awareness (20%)
19.	PBASIC(N)	188	All subjects of General Nursing & Midwifery (GNM) – 100%
20.	Bachelor of Arts (Economics) (Honours)	197	i. General English (20%) ii. Economics and Statistics (40%) iii. Mathematics (40%)

* The division of the number of questions in subparts of the syllabi is indicative.

NOTE:

1. Level of questions asked shall be as per the level of qualifying examinations for entry to the programme(s) of studies or as specified.

3.4.3 CET Syllabus for Postgraduate Diploma Programmes

S. No.	Name of Programme	CET Code	Subjects of Entrance Test*
1.	175	Advance Diploma in Child Guidance and Counselling	General awareness, Social Awareness and General English including Linguistic Expression

3.4.4 CET Syllabus for M.Sc. (Packaging Technology)

CHEMISTRY

Basic concept of the chemistry; atomic structure-quantum principles, thermodynamics; Stereochemistry; Surface chemistry; Coordination compounds-complex compounds; Chemical equilibrium; Colligative properties; periodic table; chemical kinetics; industrial chemistry; solutions; molecular structure; chemical bonds; state of matters;

Atomic Structure and Chemical Bonds: Electronic configuration of atoms, characteristics of the chemical bonds, conjugated bonds, shapes of the molecules, conformation and stereo chemistry, physical properties and molecular structures, chemical reactivity and molecular structures.

Periodic properties: trends in size, electronic affinity, ionization potential and electronegativity; Use of Ellingham diagram and thermodynamics in the extraction of elements; VSEPR theory, structure of boranes, electron counting.

Organometallic Chemistry: metal carbonyls and sandwich complexes – bonding aspects, Catalysis: Hydrogenation, hydroformylation, and olefin metathesis; Huckel treatment of ethylene, butadiene and benzenes; Concept of aromaticity; Conformation of alkanes and cycloalkanes; Reactivity of carbonyl group; Functional group interconversions; Reaction types (nucleophilic, electrophilic, free radical reactions); Molecular rearrangements; Synthetic polymers and proteins; Metal organic frameworks.

Thermodynamic: First and second law of thermodynamics, statistical treatment, free energy. The equilibrium constant and free energy changes in chemical system.

Electrochemistry: Definitions. Electrolytes, Electrodes, Anodes, Cathode, Ions, Strong and weak Electrolytes, Electroplating, Faraday's Law, Laws of Chemical Combination.

Kinetic theory of gases, Boyle's law, Charle's law, Avogadre's hypothesis, Graham's law of Diffusion, molecular velocity, gas constant deviations.

Vapour pressure, surface tension - définition, determination of surface tension, effect of temperature.

Viscosity : Definition, determination of viscosity, various viscometers, viscosity and constituents. effect of temperature.

Reference Books:

1. K.L.Kapoor, *Physical chemistry*, Published by Macmillan Publishers India Limited, 1999
2. P.C.Rakshit, *Physical chemistry* by, Published by Sarat Book House, 2014
3. Wahid U. Malik, G. D. Tuli and R. D. MADAN, *Inorganic chemistry* Published by S. Chand, 2014.
4. Wahid U. Malik, G. D. Tuli and R. D. MADAN, *Inorganic chemistry* Published by S. Chand & Company, 2010.
5. Sudharshan Guha, *Inorganic chemistry* by Wiley, 2020
6. Bahl Arun and Bahl B.S, *Organic chemistry* Published by S. Chand & Company, 2016.
7. Michael B. Smith, *Organic chemistry* Published by Wiley, 2015

PHYSICS:

Optics: Introduction, Interference, Diffraction – basic concepts, diffraction at a straight edge, diffraction at single and multiple slits, Resolving power – Rayleigh's criterion, resolving power of various optical components.

Introduction to Quantum Mechanics: Introduction to quantum physics, blackbody radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle.

Lasers and Applications: Introduction to interaction of radiation with matter, principles and working of a Laser– population inversion, pumping, various modes, threshold population inversion, types of Lasers – solid state, semiconductor, gas, applications of Lasers.

Ultrasonics: Generation of ultrasound – mechanical, electromechanical transducers, propagation of ultrasound,attenuation, velocity of ultrasound and parameters affecting it, measurement of velocity, applications of ultrasound.

Crystal Structure: Crystal structure of solids, unit cell, space lattices and Bravais lattices, Miller indices, directions andcrystallographic planes. Cubic crystals – SCC, BCC, FCC, Hexagonal crystals – HCP, atomic radius,packing fraction, Bragg's law, determination of crystal structure using Bragg spectrometer.

Semiconductors: Formation of energy bands in solids, classification of solids – conductor, semiconductor and insulator. Intrinsic semiconductor, Effect of doping – extrinsic semiconductors.

Motion, velocity and acceleration : Meaning of velocity, meaning of acceleration, graphical representation, uniform accelerated motion, motion of free falling body.

Force and laws of motion : Causes and result of force, Newton's law of motion, definition of units, force and acceleration, load factor of G' load kinetic and potential energy. Force – deformation curve.

Optics: Introduction, Interference, Diffraction – basic concepts, diffraction at a straight edge, diffraction at single and multiple slits, Resolving power – Rayleigh's criterion, resolving power of various optical components.

Introduction to Quantum Mechanics: Introduction to quantum physics, blackbody radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle.

Lasers and Applications: Introduction to interaction of radiation with matter, principles and working of a Laser– population inversion, pumping, various modes, threshold population inversion, types of Lasers – solid state, semiconductor, gas, applications of Laser.

Reference Books:

1. D. Halliday and R. Resnick, *Physics: Vols. I and II –, 2nd Ed*, Published by Wiley Eastern,1962,
2. A. Beiser, *Concepts of Modern Physics*, Published by McGraw-Hill, 1969
3. G. R. Fowles, *Introduction to Modern Optics*, 2nd Ed, Published by Dover Publications, 1975
4. R. S. Sirohi, *A Course of Experiments with LASERs, 2nd Ed*, Published by, Wiley Eastern, 1991.

ENGINEERING

Basic concepts, Circuit law, AC Fundamentals, Magnetic Circuit, Electrical Machines, Measurement and Measuring instruments, Synchronous Machines, Fractional Kilowatt Motors and single phase induction Motors, Generation, Basic Electronics, Estimation and Costing, Transmission and Distribution, Utilization and Electrical Energy.

Theory of Machines and Machine Design, 1st Law of Thermodynamics, 2nd Law of Thermodynamics, IC Engine Performance, Air standard Cycles for IC Engines, IC Engines Combustion, Boilers, IC Engine Cooling & Lubrication, Classification, Rankine cycle of System, Specification, Engineering Mechanics and Strength of Materials, Properties of Pure Substances, Air Compressors & their cycles, Fitting & Accessories, Principle of Refrigeration Plant, Nozzles & Steam Turbines, Fluid Statics, Measurement of Flow rate, Refrigeration cycles,

Properties & Classification of Fluids, Measurement of Fluid Pressure, Fluid kinematics, Dynamics of Ideal fluids, Hydraulic Turbines, Basic Principles & Classification of steel, Centrifugal Pumps

Building Materials, Surveying, Estimating, Soil Mechanics, Costing and Valuation, Concrete Technology, Irrigation Engineering, Transportation Engineering, Environmental Engineering, RCC Design, Hydraulics, Theory of Structures, Steel Design

Reference Books

1. R.S. Khurmi, Mechanical Engineering, Published by S. Chand & Company, 2018.
2. Gupta S. P and S. S. Gupta, Civil Engineering, Published by CBS, 2019.
3. Frank R. Dagostino, Joseph B. Wujek, Mechanical And Electrical Systems In Architecture, Engineering And Construction, 5th Edition, Published by Pearson, 2010
4. John R. Reisel, Principles of Engineering Thermodynamics, Si Edition, Published by Cengage Learning, 2015.

MATHEMATICS

Matrices - Introduction, types and operation, inverse, elementary transformations, rank, consistency and solution of system of linear equation, vector spaces. *Differential Calculus* - Derivative of function, higher order derivatives, rate of change of quantities, stationery points, maximum minimum problem and inflexion points. *Differential Theorem* - Taylors Theorem, absolute, relative and percentage errors, partial derivatives, homogenous functions, total derivatives, change of variables, taylor's theorem for function of two variable. *Integral Calculus and Differential Equations* - Methods of integrations, definite integrals, properties of definite integrals, area of curves, length of curves, volume and surface of revolution, formation and solution of first order differential equation.

Algebra - Brief description of algebraic properties of complex numbers, statement of fundamental theorem of algebra, solutions of quadratic equations in the complex number systems, algebraic solutions of linear in equalities in one variable and their representation of the number line, solution of algebraic and transcendental equations, finite differences and interpolation, numerical differentiations and integrations. *Polynomials* **-** scalar and vector fields, level surfaces, directional derivatives, gradient, curl, divergence, line and surface integrals, theorem of green, polynomials. *Business Mathematics* **-** Fundamental principles of counting, functional n (n!) permutation and combinations, derivation of formulae and their connections, simple applications, mathematically acceptable statements, uses through variety of examples related to real life and mathematics, numerical based on profit and losses.

Introduction of Statistics: Application of Statistics in packaging, normal distribution, dimensional analysis, measures of central tendency, average, mean, median, mode, standard deviation, standard error. Measures of dispersion coefficient of variation skewness, standard error of mean, simple correlation and regression, multiple regression

Multiple & partial: correlation, variability – range, variance. *Theory of Probability* - equally likely, mutually exclusive events, definition of probability, addition and multiplication theorems of probability and problems on theorems of probability and problems based on them. Design experiment for packaging applications, statistical quality control.

Distance Between 2 Points, 3D Geometry, Differentiation and Integration etc, Probability, Conics, Coordinate Geometry, Vector Algebra, Circles, Permutation and Combination, Functions, Integration, Matrices, Coordinate Geometry, Binomial Theorem, Coordinate Geometry, Integration, Conic Section, Circle and Tangents, Calculus, Mathematical Reasoning, Parabola, Eclipse, Arithmetic, Statistics, Probability, Set and Relation, Sequence and Series, Definite, Binomial, Area Bounded, Differentiation, Complex numbers, Sequence and Series, Algebra, Trigonometry, Integral Calculus,

Reference Books

1. H.K. Dass, *Advanced Engg. Mathematics*, Publisher by S Chand, 2018.
2. D. Hughes-Hallett, A. M. Gleason, W. G. McCallum and D. E. Flath, *Calculus: Single and Multivariable*, 7 Edition, Published by John Wiley & Sons, 2017.
3. S. R. Ghorpade and B. V. Limaye, *A Course in Multivariable Calculus and Real Analysis, Published by* Springer, 2010.
4. H. Anton, Irl Bivens D, Stephen Davis *Calculus*, John Wiley & Sons., 10th Edition, 2012.

3.4.5 CET Code 600 & 611 Syllabus for The Syllabus stated is for Bachelor of Design (B.DES.) for all three specializations namely: [a. Industrial Design; b. Interaction Design; c. Interior Design]and for Master of Design (M.DES.)for the two specializations namely: [a. Industrial Design; b. Interior Design]

CET 2022 for USDI, GGSIPU aims to adjudge students for their **Aptitude to peruse Design** as their profession.

The Syllabus stated is for Bachelor of Design (B.DES.) for all three specializations namely:
[a. Industrial Design; b. Interaction Design; c. Interior Design]
and for Master of Design (M.DES.)for the two specializations namely**:**
[a. Industrial Design; b. Interior Design]
It would be important to note that however, the subject topics are common for both B.Des and M.Des courses but the question papers would be different, more detailed, and appropriately created for the level of M.DES program.

The syllabus for the CET-2022 broadly covers topics to test the aptitude and sensitivity towards Design through a set of questionsfrom varied subjects like understanding of.

- **Analytical and logical reasoning ability**- This section looks into the knowledge of Series and Sequences of numbers, shapes, patterns, figures, and words; Identifying missing numbers, words, or figures; Blood relations; Direction and Distance; Alphabet test; Cause and effect; Clocks and Calendars; Coding and Decoding of Analogy Series; Matrix Completion; Incomplete Pattern; Spotting embedded figures; Classification Rules Detection; Identical figure groupings; Forming figures and analysis.

- **Visual aptitude**- This section would look into the knowledge of Presentation techniques; Diagrammatic Reasoning; Object and Image recognition; Venn figurative Verbal reasoning; Understanding of spatial correlation of 2D shapes and 3D objects; Cutting cubes and dice; Scale and perspective and vanishing point; Water and Mirror images. Projection of Solids, isometric drawing.

- **General awareness-** Design aspirants must have knowledge designed Arts, Artifact, Sculptures, and Literature. of social and cultural connection with the history of the design, environmentally sustainable design response, and socially responsible; implications on the design of products, images, environmental and infrastructure.

3.4.6 CET Code 613 Syllabus for LATERAL ENTRY EXAMINATION TEST [LEET] Bachelor of Design (B.DES.)

- **Analytical and logical reasoning** -This section looks into the knowledge of Series and Sequences of numbers, shapes, patterns, figures, and words; Identifying missing numbers, words, or figures; Analytical and Logical ability; Blood relations. Coding and Decoding of Analogy Series. Matrix Completion Incomplete Pattern Spotting embedded figures Classification Rules Detection. Identical figure groupings Forming figures and analysis Construction of Squares and Triangles Series Analytical Reasoning.

- **Visual aptitude**-- This section would look into the knowledge of Presentation techniques; Understanding of spatial correlation of 2D shapes and 3D objects; Cutting cubes and dice; Scale and perspective and vanishing point; Water and Mirror images. Projection of Solids, isometric drawing.

- **General awareness**-- Design aspirants must have knowledge of designed Arts, Artifact, Sculptures, and Literature of social and cultural connection with the history of the design, environmentally sustainable and socially responsible design; implications on the design of products, images, environmental and infrastructure.

- **Visual Perception**-- Principles of visual perception (Gestalt). Laws of grouping (Prägnanz), Discussion and demonstration of the way humans make a greater sense out of combination of simple or complex curves and shapes.Basic dimensions, how three dimensions build up volumes, representation of three axes in 2 D,principles of isometric and perspective drawing, simple isometric and perspective drawing in one, andtwo-point perspective.
-
- **Colors**-- Introduction to colours, pigment and light, additive and subtractive models. Shades of greys. Understanding warm and cold greys, Colour terminologies – hue, value, tint, shade, intensity, chroma, etc., Primary colours, Secondary colours, Colour wheel, Intermediate colours, Complimentary colours, Split complimentary colours, Grey scale, Colour schemes: monochromatic, warm, cool, complimentary, split complimentary, triadic, triadic,analogous,Colour interaction.

- **Geometry**-- Relationship between natural objects based on pentagon, including the vitruvious man, Fibonacci Series, Golden Ration, Divine Proportions, Golden Ratio in Nature (Relevance of golden ration. How golden ratio is used by nature in its creations. Demonstrate theimportance of golden ratio in the visual world), Tessellations In 2 Dimensions.Characteristics of a shape, concepts of positive and negative space, types of shapes, developing patterns by repetition of points, dots, rectilinear elements, curvilinear elements, shapes, Regular and Irregular patterns.

- **Principles of Design**-- Principles of design, unity/harmony, balance, alignment, hierarchy, emphasis, similarity and contrast;Scale, proportions, movement, repetition, pattern, rhythm, variety, chaos.

11. School-Wise Details:

11.1 University School of Biotechnology

11.1.1 Eligibility Criteria:

Master's Degree (M.Sc./M. Tech) in Biotechnology /Life Sciences/ Botany/ Zoology/ Genetics/ Microbiology/ Biochemistry/ Plant Molecular Biology/ Biochemical Engineering/ Bioinformatics/ or Allied Sciences.

OR

MD/MS/MDS in any branch of Medical Sciences,

OR

M. Pharma or equivalent degree

OR

M. Phil with Master's in Biotechnology/Life Sciences/ Botany/ Zoology/ Genetics/ Microbiology/ Biochemistry /Plant Molecular Biology/ Biochemical Engineering/ Bioinformatics/or Allied Sciences.

A degree considered equivalent to M.Phil. Degree of a Indian Institution, from a Foreign Educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to Ph.D. programme.

11.1.2. Mode of Ph.D. Programme:

Full Time

11.1.3. Syllabus for Entrance Test:

Part A - Research methodology

Scientific Research: Meaning and characteristics of scientific research; Validity in research; Phases or stages in research; Various types of research: Quantitative, Qualitative, Experimental, Exploratory, Empirical, Descriptive, Ex-post facto, Case studies.
Review of literature: Purpose of the review, Sources of the review, Citing references, Ethical and IPR issues in research.
Data representation: Collection of data, Tabulation, Organization and graphical representation of quantitative data: Line Graphs, Bar Graphs, Pie Charts, Histograms; Probability concept and theories.
Sampling: Meaning and types of sampling, Probability and Non probability Sampling. Methods of drawing random samples, requisites of good sampling methods, Sample size, Sampling error.
Hypothesis testing: Null hypothesis, Alternate hypothesis, Steps of hypothesis testing, Level of significance, Type I and Type II error.
Measures of Variability: Range; Quartile Deviation; Standard Deviation; Average Deviation; and Coefficient of Variation; Measures of Relative position: Percentiles, Percentiles Ranks, Standard Scores, Stanine Scores, T- Scores; Normal Probability Distribution, properties of normal curve, applications of normal curve, Divergence from Normality : Skewness and Kurtosis.
Correlation and Regression: Karl Pearson's correlation Coefficient(r), Spearman's rank order correlation coefficient (rho), Partial and Multiple Correlation, Scatter diagrams, Regression and Prediction, Regression equations, linear regression, multiple regression analysis, Cause and effect-Path analysis
Statistical inference: Concept of Standard Error and it's uses; The Significance of Statistical Measures; Tests of Significance of Difference between two means Z-Test, T-test; Analysis of

variance and analysis of covariance: Assumptions of Anova, One way Anova, Two way Anova, Post Hoc tests- Duncan's multiple range test, Tukey's test, Newmann-Keuls test; Non-parametric Tests: Chi-square test, Medium test, Mann Whitney U test, Kolmogorov- Smirnov two sample test; Multivariate analysis: Factor analysis, Cluster analysis and Discriminant analysis.
Experimental Designs: Meaning and purpose of research design, Criteria of research design, Basic principles of experimental design, General layout and Anova of experimental designs: Completely Randomized Design, Randomized Block Design, Latin Square Design, Split Plot, Factorial designs.
Preparation of Thesis: Introduction to scientific writing, Introduction to different softwares used for thesis preparation.

Part B – Biotechnology (Subject Specific Test)

Biochemistry: Organization of life; Importance of water; Structure and function of biomolecules: Amino acids, Carbohydrates, Lipids, Proteins and Nucleic acids; Protein structure, folding and function

Enzyme classification, kinetics including its regulation and inhibition, Vitamins and Coenzymes; Metabolism and bioenergetics; Generation and utilization of ATP; Metabolic pathways and their regulation: glycolysis, TCA cycle (Krebs' cycle), glycolysis, pentose phosphate pathway, oxidative phosphorylation, electron transport chain; gluconeogenesis, glycogen and fatty acid metabolism; Metabolism of nitrogen containing compounds: nitrogen fixation, amino acids and nucleotides. Photosynthesis: Calvin cycle, C4 Cycle, CAM

Cell Biology: Cell structure and organelles; Biological membranes; Transport across membranes; Signal transduction; Hormones and neurotransmitters; Prokaryotic and eukaryotic cell structure; Cell cycle, cell division and cell growth control; Cell-Cell communication, Cell signaling and signal transduction

Molecular Biology and Genetics: Molecular structure of genes and chromosomes; Mutations and mutagenesis; Nucleic acid replication, transcription, translation and their regulatory mechanisms in prokaryotes and eukaryotes; Mendelian inheritance; organization of genome, sex determination and sex-linked characteristics, cytoplasmic inheritance, linkage, recombination and mapping of genes in eukaryotes, population genetics. Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extra chromosomal inheritance; Microbial genetics (plasmids, transformation, transduction, conjugation); Viruses, Retroviruses; Transposable elements; RNA interference; DNA damage and repair; Chromosomal variation; Molecular basis of genetic diseases Microarray, PCR, site directed mutagenesis, microarray, DNA sequencing

Analytical Techniques: Principles of microscopy-light, electron, fluorescent and confocal; Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, CD, IR, FTIR, Raman, MS, NMR; Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, affinity, GC,HPLC, FPLC; Electrophoresis; Flowcytometry

Immunology: History of Immunology, Active and passive immunity; Innate, humoral and cell mediated immunity; Antigen; Antibody structure and function; Molecular basis of antibody diversity; Synthesis of antibody and secretion; Antigen-antibody reaction; Complement; Primary and secondary lymphoid organ; B and T cells and macrophages; Major histocompatibility complex (MHC); T cell receptor; Antigen processing and presentation; Polyclonal and monoclonal antibody; Regulation of immune response; Immune tolerance; Hypersensitivity; Autoimmunity; Graft versus host reaction. Immunological techniques: Immunodiffusion, immunoelectrophoresis, RIA and ELISA.

Bioinformatics: Major bioinformatic resources and search tools; Sequence and structure databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny); Data mining and analytical tools for genomic and proteomic studies; Molecular dynamics and simulations (basic concepts including force fields, protein-protein, protein-nucleic acid, protein-ligand interaction)

Recombinant DNA Technology: Restriction and modification enzymes; Vectors; plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; mammalian and plant expression vectors; cDNA and genomic DNA library; Gene isolation, cloning and expression; Transposons and gene targeting; DNA labeling; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD, RFLP, AFLP, SSRs, SNPs; Gene transfer technologies; Gene therapy

Plant and Animal Biotechnology: Totipotency; Regeneration of plants; Plant growth regulators and elicitors; Tissue culture and Cell suspension culture system: methodology, kinetics of growth and, nutrient optimization; Production of secondary metabolites by plant suspension cultures; Hairy root culture; transgenic plants; Plant products of industrial importance; Animal cell culture, media composition and growth conditions; Animal cell and tissue preservation; Anchorage and non-anchorage dependent cell culture; Kinetics of cell growth; Micro & macro-carrier culture; Hybridoma technology; Stem cell technology; Animal cloning; Transgenic plants and animals

Bioprocess Engineering and Process Biotechnology: Chemical engineering principles applied to biological system, Principle of reactor design, ideal and non-ideal multiphase bioreactors, mass and heat transfer; Rheology of fermentation fluids, Aeration and agitation; Media formulation and optimization; Kinetics of microbial growth, substrate utilization and product formation; Sterilization of air and media; Batch, fed-batch and continuous processes; Various types of microbial and enzyme reactors; Instrumentation control and optimization; Unit operations in solid-liquid separation and liquid-liquid extraction; Process scale-up, economics and feasibility analysis

Engineering principle of bioprocessing: Upstream production and downstream; Bioprocess design and development from lab to industrial scale; Microbial, animal and plant cell culture platforms; Production of biomass and primary/secondary metabolites; Biofuels, Bioplastics, industrial enzymes, antibiotics; Large scale production and purification of recombinant proteins; Industrial application of chromatographic and membrane based bioseparation methods; Immobilization of biocatalysts (enzymes and cells) for bioconversion processes; Bioremediation-Aerobic and anaerobic processes for stabilization of solid / liquid wastes.

Evolution: Origin and history of life on earth, theories of evolution, natural selection, adaptation, speciation.

Developmental Biology: Embryonic development, cellular differentiation, organogenesis, metamorphosis, genetic basis of development,

Microbiology: Discovery of microbial world: Landmark discoveries relevant to the field of microbiology; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases. Methods in Microbiology: Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Enrichment culture techniques for isolation of microorganisms; Light-, phase contrast- and electron-microscopy. Microbial Taxonomy and Diversity: Bacteria, Archea and their broad classification; Eukaryotic microbes: Yeasts, molds and protozoa; Viruses and their classification; Molecular approaches to microbial taxonomy. Microbial Growth:Definition of growth; Growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; Effect of environmental factors on growth. Control of Micro-organisms: Effect of physical and chemical agents; Evaluation of effectiveness of antimicrobial agents. Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; Emerging infectious diseases; Mechanism of microbial pathogenicity; Nonspecific defense of host; Vaccines; Immune deficiency; Human diseases caused by viruses, bacteria, and pathogenic fungi; Chemotherapy/Antibiotics: General characteristics of antimicrobial drugs; Antibiotics: Classification, mode of action and resistance; Antifungal and antiviral drugs; Microbial Ecology: Microbial interactions; Carbon, sulphur and nitrogen cycles; Soil microorganisms associated with vascular plants.

Plant Systematics: Nomenclature; Major systems of classification, plant groups, phylogenetic relationships and molecular systematics.

Plant Anatomy: Plant cell structure and its components; cell wall and membranes; organization, organelles, cytoskeleton, anatomy of root, stem and leaves, floral parts, embryo and young seedlings, meristems, vascular system, their ontogeny, structure and functions, secondary growth in plants and stellar organization.

Plant Morphogenesis & Development: Life cycle of angiosperms, pollination, fertilization, embryogenesis, seed formation, seed storage proteins, seed dormancy and germination.

Plant Physiology: Plant water relations, transport of minerals and solutes, stress physiology, stomatal physiology, signal transduction, N2 metabolism, photosynthesis, photorespiration; respiration, Flowering: photoperiodism and vernalization, biochemical mechanisms involved in flowering; molecular mechanism of senecence and aging, biosynthesis, mechanism of action and physiological effects of plant growth regulators

Plant Breeding and Genetic Modification: Principles, methods – selection, hybridization, heterosis; male sterility, genetic maps and molecular markers, sporophytic and gametophytic self incompability, haploidy, triploidy, somatic cell hybridization, marker-assisted selection, gene transfer methods viz. direct and vector-mediated, plastid transformation, transgenic plants and their application in agriculture, molecular pharming, plantibodies.

Economic Botany: A general account of economically and medicinally important plants- cereals, pulses, plants yielding fibers, timber, sugar, beverages, oils, rubber, pigments, dyes, gums, drugs and narcotics; Economic importance of algae, fungi, lichen and bacteria.

Plant Pathology: Nature and classification of plant diseases, diseases of important crops caused by fungi, bacteria,nematodes and viruses, and their control measures, mechanism(s) of pathogenesis and resistance, molecular detection of pathogens; plant-microbe beneficial interactions.

Ecology and Environment: Ecosystems – types, dynamics, degradation, ecological succession; food chains and energy flow; vegetation types of the world, pollution and global warming, speciation and extinction, conservation strategies, cryopreservation, phytoremediation.

Food Chemistry and Nutrition: Carbohydrates: structure and functional properties of mono-, oligo-, & poly- saccharides including starch, cellulose, pectic substances and dietary fibre, gelatinization and retrogradation of starch. Proteins: classification and structure of proteins in food, biochemical changes in post mortem and tenderization of muscles. Lipids: classification and structure of lipids, rancidity, polymerization and polymorphism. Pigments: carotenoids, chlorophylls, anthocyanins, tannins and myoglobin. Food flavours: terpenes, esters, aldehydes, ketones and quinines. Enzymes: specificity, simple and inhibition kinetics, coenzymes, enzymatic and non- enzymatic browning. Nutrition: balanced diet, essential amino acids and essential fatty acids, protein efficiency ratio, water soluble and fat soluble vitamins, role of minerals in nutrition, co-factors, anti-nutrients, nutraceuticals, nutrient deficiency diseases. Chemical and biochemical changes: changes occur in foods during different processing. Food Microbiology: Characteristics of microorganisms: morphology of bacteria, yeast, mold and actinomycetes, spores and vegetative cells, gram-staining. Microbial growt h: growth and death kinetics, serial dilution technique. Food spoilage: spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products. Toxins from microbes: pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera. Fermented foods and beverages: curd, yoghurt, cheese, pickles, soya-sauce, sauerkraut, idli, dosa, vinegar, alcoholic beverages and sausage.

Food Products Technology: Processing principles: thermal processing, chilling, freezing, dehydration, addition of preservatives and food additives, irradiation, fermentation, hurdle technology, intermediate moisture foods. Food pack aging and storage: packaging materials, aseptic packaging,

controlled and modified atmosphere storage. Cereal processing and products: milling of rice, wheat, and maize, parboiling of paddy, bread, biscuits, extruded products and ready to eat breakfast cereals. Oil processing: expelling, solvent extraction, refining and hydrogenation. Fruits and vegetables processing: extraction, clarification, concentration and packaging of fruit juice, jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, and puree, potato chips, pickles. Plantation crops processing and products: tea, coffee, cocoa, spice, extraction of essential oils and oleoresins from spices. Milk and milk products processing: pasteurization and sterilization, cream, butter, ghee, ice- cream, cheese and milk powder. Processing of animal products: drying, canning, and freezing of fish and meat; production of egg powder. Waste utilization: pectin from fruit wastes, uses of by-products from rice milling. Food standards and quality maintenance: FPO, PFA, Agmark, ISI, HACCP, food plant sanitation and cleaning in place (CIP).

11.2 University School of Chemical Technology

11.2.1. Additional Eligibility Criteria:

Candidates for admission to the Ph.D. programme should have a M.Tech or equivalent degree in Chemical Technology / Chemical Engineering / Allied fields by the corresponding statutory regulatory body, with at least 55% marks in aggregate. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, shall be allowed for those belonging to SC/ST/Differently-Abled (PWD)

11.2.2. Mode of Ph. D. Programme:

Full Time/Part Time

11.2.3. Syllabus for Entrance Test:

Part A - Research Methodology

Linear Algebra: Solution of linear algebraic equation, Matrices, Eigen values and Eigenvectors.

Calculus: Functions of single variable, Limit, Continuity and differentiability, Mean value theorems, Maxima and Minima.

Differential equations: Ordinary differential equation; Initial and boundary value problems, Partial differential equation.

Introduction to Statistics: Statistical concept, Statistical Inference, Statistical Hypotheses, Statistical Estimation, Point Estimates, Interval Estimates, Quantitative Data Graphs.

Qualitative Data Graphs, Graphical Depiction of Two-Variable, Numerical Data, Scatter Plots

Descriptive Statistics: Measures of Central Tendency-mean, Median and Mode, Measures of Variability- Data range, Variance and standard deviation, Measures of shape of distribution of data, Tests and estimates on statistical variance.

Research Ethics: Research honesty and integrity, Authorship, Acknowledgement and citation, Funding agencies and sponsorship, Sources of data, Sensitive materials and safety, Patents and copyright, Confidentiality and privacy, Human rights, Environmental laws, Fabrication of data and misrepresentation, Plagiarism.

Part B - Chemical Technology (Subject Specific Test)

Process Calculations

Steady and unsteady state mass and energy balances including multiphase, Multi Component, Reacting and non-reacting systems. Use of tie components; Recycle and bypass; Gibb‘s phase rule and degree of freedom analysis.

Thermodynamics

First and Second laws of thermodynamics, Applications of first law to close and open systems, Second law and Entropy, Thermodynamic properties of pure substances, Equation of State, Properties of mixtures, Partial molar properties, Fugacity, Excess properties and activity coefficients, Phase Equilibrium: Chemical reaction equilibrium.

Fluid Mechanics

Fluid statics, Newtonian and non-Newtonian fluids, Basic equation of fluid flow, Macroscopic friction factors, Dimensional analysis, Flow through pipes and channels, Flow meters, Pumps, Elementary boundary layer theory, Flow past immersed bodies including packed and fluidized beds.

Heat Transfer

Conduction, Convection and Radiation, Thermal boundary layer, Heat transfer coefficients, Boiling, Condensation and Evaporation, Design of double pipe and shell and tube heat exchangers, Single and multiple effect evaporators.

Mass Transfer

Fick‘s laws, Molecular diffusion in fluids, Mass transfer coefficients, Film, Penetration and surface renewal theories; Momentum, heat and mass transfer analogies; Stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; Design and operation of equipment for distillation, Absorption.

Chemical Reaction Engineering

Theories of reaction rates, Kinetics of homogeneous reactions, Interpretation of kinetic data, Single and multiple reactions in ideal reactors, Residence time distribution.

Instrumentation and Process Control

Measurement of process variables; Sensors, Transducers and their dynamics, Process modelling and linearization, Transfer functions and dynamic responses of various systems, Systems with inverse response, Process reaction curve, Controller modes (P, PI, and PID); Control valves; Analysis of closed loop systems including stability, Frequency response, Controller tuning, Cascade and feed forward control.

Chemical Technology

Inorganic chemical industries (Sulphuric acid, Phosphoric acid, Chloral-alkali industry), Fertilizers (Ammonia, Urea, SSP and TSP); Natural products industries (Pulp and Paper, Sugar, Oil, and Fats); Petroleum refining and petrochemicals; Polymerization industries (Polyethylene, Polypropylene, PVC and Polyester synthetic fibbers).

11.3 University School of Management Studies

11.3.1. Additional Eligibility Criteria:

Candidates for admission to the Ph. D. programme shall have a Master Degree in Management or related field or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7 –point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions. Master Degree in Management field or related fields like Masters in Economics/Psychology/Sociology/ Commerce/Operation Research/ Statistics/IT/Computer Applications are eligible for Ph. D. Further more, sectoral MBA Programmes such as MBA (Rural Management), MBA(Real Estate), MBA (Energy Management), MBA(Environment Management), MBA(Disaster Management), MBA (Health Care Management), Masters in Hospital Administration / MBA(Banking & Insurance) etc shall also be eligible for admission to the Ph. D. Programme.

11.3.2. Mode of Ph. D. Programme:

Full Time/Part Time

11.3.3. Syllabus for Entrance Test:

Part A – Research Methodology

Relevance and Scope of Business Research; Steps in Research Process; Statement of Research Problem, Research Question and Research Hypothesis; Research Designs- Functions, Exploratory, Descriptive, Experimental; Experimental Research Designs-Pre-Experimental, Quasi-Experimental, True Experimental; Qualitative Versus Quantitative Research; Types of Qualitative Data Collection Techniques; Types of Measurement Scales; Questionnaire Development; Types of Attitudes Scales; Validity of Research Instruments-Face, Content, Criterion, and Construct Validity; Reliability of Research Instruments; Sources and Methods of Data Collection; Sampling- Benefits and Limitations, Types of Probability and Non-Probability Sampling Methods, Sampling Frame, Sample Size Determination, Sampling Errors; Data Analysis- Descriptive Statistics, Overview of Univariate, Bivariate and Multivariate Techniques, Parametric Vs. Non-Parametric Tests, Correlation Analysis, Multiple Regression, Selection of Appropriate Statistical Tools for Hypothesis Testing, Types of Errors; Guidelines for Report-Writing; Research Ethics; Management Research-Epistemological and Ontological Perspectives.

Part B – Management (Subject Specific Test)

Managerial Economics- Demand Analysis, Production Function, Cost-Output Relations, Market Structures, Pricing Decisions; **Management Processes and Organization Behaviour**- Classical, Neo – Classical and Modern Theories of Management; Personality, Perception, Values, Attitudes, Learning, Employee Motivation, Leadership, Managing Conflicts**; Human Resource Management**- Human Resource Planning, Job Analysis, Recruitment and Selection, Training and Development, Performance Appraisal; **Financial Management** – Valuation Concepts and Valuation of Securities, Capital Budgeting Decisions, Capital Structure and Cost of Capital, Dividend Policy, Long-Term and Short Term Financing; **Marketing Management**- Marketing Philosophies, Marketing Environment, Consumer and Industrial Markets, Market Segmentation, Targeting and Positioning,

Product Decisions, Pricing Strategies, Promotion Decisions, Distribution Decisions, Customer Relationship Management; **Information Systems**-Business Value of Information Systems, IS Organization and Strategy, Principal Methodologies in Building Information Systems, Trends in Information Technology; **Operations Management**- Product Development, Process Strategies, Facility Location and Layout, Capacity Strategies, Production Planning and Control, Lean Management, Total Quality Management; **Legal Aspects of Business**- Formation of Contract and Essentials of a Contract, Company Law & Corporate Governance, Consumer Protection and Competition Law; **Strategic Management**- Concept of Corporate Strategy, Strategic Management Process, Environmental Analysis, Porter's Generic Strategies, Strategies in Industry Evolution, Global Entry Strategies; **Entrepreneurship Development**- Entrepreneurship and Economic Development, Economic and Non-Economic Factors affecting Entrepreneurial Growth, Entrepreneurial Development Programs, Entrepreneurial Opportunity Identification, Feasibility Analysis, Preparation of a Business Plan, Role of Support Institutions.

11.4 University School of Environment Management

11.4.1. Additional Eligibility Criteria:

M.Sc. Environmental Science/ Environment Management/ Natural Resource Management/ Biodiversity & Conservation/Life Sciences/ Botany/ Zoology/ Physical Sciences/ Chemical Sciences/ M.Tech. Engineering/Sciences. Graduation in Sciences/ Engineering is mandatory

11.4.2. Mode of Ph. D. Programme:

Full Time/ Part Time

11.4.3. Syllabus for Entrance Test:

Part A – Research Methodology

1. Environmental Statistics and Research Design

Statistics: Probability, Measures of central tendency and their attributes, Descriptive statistics and Measurement Scales, Control Chart, Confidence interval, estimation of Mean, Tests of Hypothesis, Normal probability distribution, Z test with known variance, Sample t test: Correlation and Linear regression.

Sampling Design: deliberate, simple random, systematic, stratified, quota and cluster sampling, method of selecting Sample size, location and time.

Research Design: probability/non-probability design, exploratory/Formulative research, informal/Formal Design.

2. Instrumentation in Environmental Studies

Principles of photometry, laws governing photometry (Beer's and Lambert's Law), basics of Colorimeter and Spectrophotometer, fundamentals of Chromatography, thin layer chromatography (TLC), Gas Chromatography (GC), HPLC, Flame Photometer, atomic absorption spectroscopy.

Principles of microscopy: microtomy, compound microscopy, Basic principles of Scanning Electron Microscopy (SEM), principle, methodology and applications of electrophoresis, Polymerase Chain Reaction (PCR), cryopreservation.;

3. Ecological Methods

Phyto-sociological studies: vegetational study through survey methods- frequency, density, abundance, cover and basal area, IVI, dispersion; species diversity assessment through quadrat method, point centre quarter method, biodiversity assessment and indices-Shannon-Wiener index, Simpson's Diversity Index, alpha, beta and gamma diversity.

Assessment of forest vegetation- vegetation profile, canopy cover measurement, tree height and biomass assessment, tree carbon assessment, leaf area index (LAI).

Ethnobotanical and ethnobiological survey method, walk through transect method.

Assessment of ecological parameters of wetland ecosystem (physical, chemical biological)

Field Techniques in wildlife studies: line/belt transect, Quadrat sampling, point count, scan sampling, focal sampling, Ad libitum sampling, wildlife telemetry, remotely triggered camera trapping, avian acoustics, population estimation methods, mark-recapture for closed populations, distance based sampling.

Socio- Economic Survey methods, participatory rural appraisals (PRA) methods, valuation of ecosystem services- travel cost method, market Price Method, Surrogate Market Approaches, Hedonic Pricing, Contingent Valuation method.

4. Environmental Analytical Methods

Air analysis: Objectives of air quality monitoring, location of sampling stations, physical site factors, period, frequency and duration of sampling. common sampling procedures and equipment, respirable dust sampler, monitoring of SO2, West and Gaeke method, monitoring of NO2, Jacobs and Hochheiser method, methods of CO monitoring, infrared CO analyser.

Water analysis: aims and objectives of water pollution monitoring, suspended solids, hardness, turbidity, TDS, pH, Eh, dissolved oxygen, BOD and COD monitoring, oil and grease, metals and persistent organic pollutants.

Soil analysis: color, texture, bulk density, soil conductivity, soil analysis for available phosphorus, nitrogen potassium, sulphur and estimation of soil organic carbon.

5. Taxonomy and Biogeography

Field collection, equipments, preservation and identification techniques of aquatic and terrestrial plant groups; herbarium handling and data Information Systems; herbarium policies; major herbaria, Botanical Gardens and Zoological Gardens/Zoo of the World and their significance in taxonomic research. Collection and preservation of curating specimens of various animal groups. use of taxonomic literature; taxonomic keys; identification through websites/internet.

6. Environmental Microbial Technology

Sterilization Methods: heat sterilization, radiation, filtration and chemical sterilization, principles of autoclave and biosafety cabinet, disinfection.

Culture Media: types-complex and defined media, role of various components, differential and selective media, solid media.

Basic Microbial Techniques: streaking, spreading, slant preparation, colony forming units, MPN method for coliforms, Gram staining, aseptic techniques.

Basic features of bacteria, fungi and algae, bacteria growth curve.

Instruments for basic microbiological studies: incubator, Laminar Flow, autoclave centrifuge, incubator shaker.

7. Remote Sensing and GIS Techniques

Basics and Principles of Remote Sensing, Electromagnetic spectrum, spectral signature, remote sensing platforms, Digital image processing, Image characteristics and interpretation. Basics and Principles of GIS, GIS data model. Functions of raster and vector data models. Applications of Remote Sensing and GIS in environment, natural resources and disaster management.

Part B - Environmental Science (Subject Specific Test)

8. General Environment and Ecology

Scope and application of Environmental Science.

Ecological Factors: Concept of limiting factors. biotic and abiotic factors.

Population Ecology: Properties of population, growth models, demographic model, concept of carrying capacity.

Community Ecology: Community structure, types of interaction between species, concept of habitat, niche and guild.

Ecosystem: Concept, trophic structure, energy flow, nutrient cycling, ecological foot print. Ecological succession, ecosystem regulation, integrity and resilience, Urban ecosystem, Ecosystem services.

Concepts of landscape ecology and its elements; ecosystem restoration.

9. Natural Resources

Classification of natural resources, ecological, social and economic dimension of resource management.

Land resources: Land as a resource. types of soils, properties, formation and distribution, soil erosion, soil conservation; mineral resources-types and uses.

Forest resources: Major forest types and their characteristics, forest ecology, afforestation, regeneration, sustainable forest management, deforestation, non-timber forest products.

Water resources: Properties of lentic and lotic aquatic resources, conflicts over water, wetlands, rain water harvesting.

Energy resources: Conventional energy resources, fossil fuels and their classification, characteristics of coal, petroleum and natural gas, Nuclear fission and fusion nuclear reactors.

Non–conventional renewable energy sources: solar energy, wind energy, geo-thermal, hydropower generation, tidal and Ocean Thermal Energy Conversion (OTEC), hydrogen energy, biomass conversion technologies, gasification of biomass, biogas technology.

Food resources: World food scenario, Environmental impacts of modern agriculture, Fish and other aquatic resources.

10. Environmental Pollution

Air Pollution: air quality and emission standards, primary and secondary pollutants, Air Quality Index, Environmental and adiabatic lapse rates, temperature inversion and atmospheric stability, transport and diffusion of pollutants.

Stationery and mobile sources, air pollution control methods, photochemical smog, acid rain health impacts of air pollutants.

Noise pollution: Sources of noise exposure, noise standards and noise control measures.

Water Pollution: Sources and impacts of water pollution, water quality standards, physcio-chemical and bacteriological characteristics of water, eutrophication, ground and surface water pollution, thermal pollution of water; water and wastewater treatment technologies.

Soil Pollution: Soil contaminants and Bioremediation of contaminated soils, soil salinity, bioreclamation of degraded soils.

11. Biodiversity and Conservation

Biodiversity –definition, levels and types; scope of biodiversity science, genetic diversity, species diversity, ecosystem diversity, landscape diversity, agro-biodiversity, bio-cultural diversity and urban biodiversity

History of the earth and biodiversity patterns through geological times, speciation, current centers of biodiversity, biodiversity hotspots in India and world

Value of Biodiversity: direct and indirect value of biodiversity, ecotourism, biodiversity and religion

Flora and Fauna of India

Threats to biodiversity: habitat destruction, fragmentation, transformation, degradation and loss of land and aquatic systems

Invasive species and biological impacts of invasive species on terrestrial and aquatic systems

Extinction and biological crisis; IUCN threatened categories.

Conservation strategies: principles and network of protected Areas, establishment and need for comprehensive, threats to protected areas; community conserved Areas (CCAs), in-situ and ex-situ conservation.

12. Taxonomy, Biosystematics and Evolution

Introduction and Basic principles of taxonomy (identification, description and nomenclature) and systematic, significance of systematics, The International Code of Nomenclature (ICBN/ICN). The International Code of Nomenclature of Bacteria (ICNB) or bacteriological Code (BC), phylogenetic Code of Classification (Phylocode), introduction to phenetic methods (Taxometrics), Phylogenetic Methods (Cladistics), molecular systematic, Major systems of classification of plants, animals and microbes

Origin and Evolution of Species, Taxonomy in the implementation of the Convention on Biological Diversity (CBD), Global Strategy for Plant Conservation (GSPC), Global Taxonomic Initiative (GTI), National Biodiversity Strategy Action Plan (NBSAP), Global Biodiversity Information Facility (GBIF), Sustainable Development Goals (SDG's).

Introduction to Biogeography; types of Biogeography their aim and scope; physical geography of earth, phytochoria (biomes, realms), Phytogeographic regions of India.

13. Environment Policy, Conventions, Law and Environmental Impact Assessment

Constitutional provisions for environment protection in India (Article 48A, 58A); Wildlife Protection Act, 1972; Forest Conservation Act (Revised), 1982; Water (Prevention and Control of Pollution)

Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 as , amended 1987, Environment Protection Act, 1986; Motor Vehicle Act, 1988.

Hazardous Waste (Management and Handling) Rules, 1989; Biomedical Waste (Management and Handling) Rules, 1998, Green Tribunal Act 2010; Solid Waste (Management & Handling rules), 2000, Coastal Regulation Zone (CRZ), Wetland Regulation Rules, 2010)

Stockholm Conference 1972, Rio Declarations-Agenda 21, CITES, Montreal Protocol, Kyoto Protocol, Convention on Biological Diversity (CBD), Ramsar Convention, 1971.

Environmental Impact Assessment: definition, objectives, principles and types of EIA, Strategic Environmental Assessment (SEA), EIA methodology, environment auditing, EMS & ISO 14000, environment management plan.

14. Environmental Geosciences and Natural Disaster Management

Lithosphere, hydrosphere and atmosphere; internal structure of the earth, rock types, and soil loss equations

Renewable and non-renewable mineral resources and their distribution in India; ocean as a source of mineral resources.

Hydrological cycle and its components, watershed and its management, Geological work of air, river, glacier and ground water.

Climate of India: western disturbance, Indian monsoon, El Nino, La Nina.

Disaster Management: environmental hazards, causes and types, floods, landslides, earthquake, volcano, cyclones, tsunami, drought, forest fires and avalanche; Hyogo and Senedai Frameworks, Indian Agencies in Disaster Management, DM Act, 2005; Disaster Management Policy 2009.

15. Environment Education and Awareness

Need for Environmental education and awareness, Environmental ethics, Environment days and their significance, Environmental movements of India, Global Environmental issues, ozone depletion, global warming and climate change, Paris Agreement, sustainable development UNEP programmes toward sustainable development, Sustainable Development Goals, 2030.

Important Environmental missions of Govt. of India.

Environmental health issues and prevention.

11.5 University School of Basic & Applied Sciences

11.5.1. Additional Eligibility Criteria :

The minimum eligibility for admission shall be a Master's Degree in relevant field or equivalent as stipulated in clause 1 of admission brochure.

11.5.2. Mode of Ph. D. Programme :

Full Time

11.5.3. Syllabus for Entrance Test :

Part A – Research Methodology (Mathematics)

Unit-1: Basic quantitative concepts and techniques

Types of data, description of data, frequency distributions, bar, pie charts, graphs, mean, median. mode, standard deviation, error bars, dependent and independent variables, discrete and continuous random variables, probability, sample space, outliers, statistical inference, standard normal distribution, statistical significance, chi square test, comparing data, correlations, curve fitting'

This part shall contain questions-pertaining to General Aptitude with emphasis on logical reasoning, graphical analysis. analytical and numerical ability. quantitative comparison, series formation, puzzles etc.

Part B – Mathematics (Subject Specific Test)

Linear Algebra: Finite dimensional vector spaces, Linear transformations and their matrix representations, rank, systems of linear equations, eigen values and eigen vectors, minimal polynomial, Cayley-flainilton Theorem. diagonalization, Hermitian. Skew-Herrnitian and Unitary matrices. Finite dimensional inner product spaces.

Complex Analysis: Analytic functions. conformal mappings. bilinear transformations, complex integration. Cauchy's integral theorem and formula, Liouville's theorem, maximum modulus principle, Taylor and Laurent's series, residue theorem and applications for evaluating real integrals, transcendental functions like trigonometric, exponential and Hyperbolic.

Real Analysis :Sequences and series of functions. uniform convergence. poeaer series. Fourier series. functions of several variables, maxima, minima. Rieman' integrations. multiple integrals. line, surface and volume integrals, Green's, Stokes and Gauss theorem, metric spaces, completeness, Weirstrass approximation theorem. compactness, Lebesgue measure. measurable functions, Lebesgue integral, Fatou's lemma dominated convergence theorem. Limit. continuity, Derivative, Partial Derivative.

Ordinary Differential Equations : First order ordinary differential equations, existences and uniqueness theorems, system of linear first order ordinary differential, equations, linear ordinary differential equations of higher order with constant coefficients. linear second order ordinary differential equations with variable coefficients. method of Laplace transtbrins for solving ordinary differential equations, series solutions, Legendre polynomial and Bessel functions with their properties.

,algebra: Normal subgroups and homomorphism theorems. automorphisms, Group actions. Sylow's theorems and their applications, Euclidean domains, Principle ideal domains and unique factorization domains Prime ideals and maximal ideals in commutative rings. Fields, finite fields.

Functional Analysis:Banach spaces, Hahn-Banach extension theorem, open mapping and closed graph theorems, principle of uniform boundedness, IIilbert spaces, orthonormal bases. RiCS4 representation theorem, bounded linear operators.

Numerical Analysis: Numerical solutions of algebraic and transcendental equations: bisection. secant method. Newton-Raplison method, fixed point iteration, interpolation, error of polynomial interpolations. Lagrange. Newton interpolations, numerical differentiation. numerical integration. Trepzoidal and Simpson rules. Gauss Legendre quadrature, method of undetermined parameters, le•Ft square polynomial approximation, numerical solutions of systems of linear equations, direct methods (Gauss eliminations. LU decomposition), iterative methods (Jacobi and Gauss-Seidel), matrix eigen value problems, power method, numerical solution of ordinary differential equations, initial value problems. Taylor series methods. Euler's method. Runge¬Kutta methods.

Partial Differential Equations: Linear and quasilinear first order partial differential equations. method of characteristics, second order linear equations in two variables and their classifications, Cauchy, Dirichlet and Neumann problems, solutions of Laplace. wave and diffusion equations in two variables. Fourier transform, Laplace transform.

Mechanics:Generalized coordinates. Lagrange's equations, Hamiltonian canonical equations. Hamilton's principle and principle of least action, Two Dimensional motion of rigid bodies, Euler's dynamical equations for the motion of rigid body about an axis, Theory of small oscillations, Virtual work and moment of inertia.

Probability and Statistics: Probability space. conditional probability, Baye's theorem, independence, Random variables, joint and conditional distributions. standard probability distributions and their properties, expectations, conditional expectation. moments. Weak and Strong law of large numbers. central limit theorem. Sampling distributions. Testing of hypotheses, standard parametric tests based on normal. chi-square, t. F-distributions. Linear regression, interval estimation.

Linear programming: Linear programming problem and its formulation, convex sets and their properties. graphical method. basic feasible solution, simplex method. big-M and two phase methods, infeasible and unbounded Ll'Irs, alternate optima. Dual problem and duality theorems. dual simplex method and its application in post optimality analysis, Balanced and unbalanced transportation problems. different methods for solving transportation problems. assignment problems. Sensitivity Analysis.

NB: The syllabus for Part-A is as defined by UGC/CSIR-NET for general aptitude paper Part A.

Part A – Research Methodology (Physics)

Unit-I: Research Ethics

Research honesty and integrity, authorship, acknowledgment and citations, funding agencies and sponsorship, sources of data, sensitive materials and safety. patents & copyright, confidentiality and privacy, animal and human rights. environmental laws, scientific misconduct - fabrication of data and misrepresentation, plagiarism.

Unit II Experimental Techniques: High Vacuum: Diffusion Pump. Turbo Molecular Pump, and Gauges for measuring high vacuum. Preparation of Materials: Crystal Growth, Amorphous materials, Nanomaterials, Polymers, Thin films. Device Fabrication: Oxidation. Diffusion, Ion Implantation, Metallization, Lithography and Etching, Bipolar and MOS device fabrication. Characterization Techniques: XRD, AFM, TEM, SEM. UV-VIS, micro-Raman, Luminescence, Ellipsometry-, NMR

Unit III Numerical and Computational techniques: Numerical solutions of differential equations - Euler's method, Runge-Kutta method, Numerical integration: Rectangular method , Simpson's rule, Root finding

Part B - Physics (Subject Specific Test)

Unit-I. Classical Mechanics: Rigid body dynamics, moment of inertia tensor, Non- inertial frames and pseudoforces, Small oscillations, normal modes, Variational principle, Generalized coordinates, Lagrangian and Hamiltonian formalism and equations of motion, phase space dynamics.

Unit-II Quantum Mechanics: Schrödinger equation (time -dependent and time- independent). Hydrogen atom, Eigenvalue problems (particle in a box. harmonic oscillator in 3D, etc.). Tunneling through a barrier. Time independent perturbation theory and applications, WKB approximation

Unit-Ill Electrodynamics: Electric fields, potentials, Maxwell's equations in free space and linear isotropic media, boundary conditions on the fields at interfaces, Dynamics of charged particles in static and uniform electromagnetic fields, Electromagnetic waves. Radiation- from moving charges and dipoles and retarded potentials.

Unit-IV Thermodynamic and Statistical Physics: Phase space, micro- and macro-states, Micro-canonical, canonical and grand-canonical ensembles and partition functions, thermodynamical functions, Classical and quantum statistics, Ideal Bose and Fermi gases, Bose-Einstein condensation.

Unit-V Mathematical Physics: Vector calculus, Special functions and applications (Hermite, Besse!, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions, Partial differential equations (Laplace, wave and heat equations in two and three dimensions).

Unit VI Electronics and Experimental methods: Semiconductor devices, diodes, junctions, Field effect devices, Opto-electronic devices. Operational amplifiers and their applications. Digital techniques and applications. Microprocessors and Microcontrollers.

Unit-VII Atomic & Molecular Physics: Quantum states of an electron in an atom, Spectrum of Helium and alkali atoms, hyperfine structure and isotope shift, width of spectrum lines, LS and ij coupling, Zeeman, Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules, Basic Lasers Physics

Unit VIII Condensed Matter Physics: Bravais lattices. Reciprocal lattice. Diffraction and the structure factor, phonons. lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity, Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors, Superconductivity.

Part A – Research Methodology (Chemistry)

Unit-I: Types of data, description of data, frequency distributions, bar, pie charts, graphs, mean, median, mode, standard deviation, error bars, dependent and independent variables, discrete and continuous random variables, probability, sample space, outliers, statistical inference, standard normal distribution, statiscal significance, chi square test, comparing data, correlations, curve fitting.

Unit-II: Research Ethics Research honesty and integrity, authorship, acknowledgment and citations, funding agencies and sponsorship, sources of data, sensitive materials and safety, patents & copyright, confidentially and privacy, animal and human rights, environmental laws, scientific misconduct-fabrication of data and misrepresentation, plagiarism.

Unit-III: Separation and Characterization techniques: Problems relating to structural analysis of chemical compounds and materials using, IR, UV-VIS, NMR, ESR, Mass spectroscopy, SEM-EDX, TEM and XRD (Powder and single crystal); Chromatographic techniques: GC-MS, LC-MS; Thermal analysis (TGA, DTA, DSC).

Unit-IV: Chemical Safety and Ethical Handling of Chemicals: Safe working procedure and protective environment, protective apparel. laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals.

Part B – Chemistry (Subject Specific Test)

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochcmistry: Configurational and conformational isomerism in acyclic and cyclic compounds: stereogenicity, stereoselectivity, enantioselectivity. diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds — generation and reactions.

4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals. carbenes, benzynes and nitrenes.

5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.

6. Common named reactions and rearrangements -- applications in organic synthesis

7. Chemistry of natural products: Carbohydrates, proteins, fatty acids, nucleic acids.

Inorganic Chemistry

1. Chemical periodicity

2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSFPR Theory).

3. Concepts of acids and bases. Hard-Soft acid base concept. Non-aqueous solvents.

4. Main group elements and their compounds: Allotropy. synthesis. Structure and bonding. Industrial importance of the compounds.

5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.

6. Organometallic compounds: synthesis, bonding and structure. and reactivity. Organometallics in homogeneous catalysis.

7. Nuclear chemistry: nuclear reactions. fission and fusion.

Physical Chemistry

1. Atomic structure and Chemical bonding in diatomics: elementary concepts of MO and VB theories.: 1 luckel theor} for conjugated It-electron systems.

2. Chemical applications of group theory: symmetry el elements point groups: character tables; selection rules. 6. Molecular spectroscopy Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities - selection rules; basic principles of magnetic resonance.

3. Chemical thermodynamics: Laws. state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle;

4. Electrochemistry: Nernst equation, redox systems, electrochemical cells: DebyeHuckel theory: electrolytic conductance - Kohlrausch's law and its applications; ionic equilibrium: conduct metric and potentiometric titrations.

5. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions: steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

6. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

7. Polymer chemistry: Molar masses; kinetics of polymerization.

11.6 University School of Humanities & Social Sciences

11.6.1. Mode of Ph. D. Programme (Ph.D. English):

Full Time

11.6.2. Eligibility (Ph.D. English)

1.1 Candidates seeking admission to the Ph.D. programme should have a Master's Degree in English or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing accrediting or assuring quality and standards of educational institutions.

1.2. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, shall be allowed for those belonging to SC/ST/Differently-Abled (PWD) categories.

1.3. A candidate whose M.Phil. Dissertation has been evaluated but the viva-voce is pending may be admitted to the Ph.D. programme in the same USS.

1.4. Candidates possessing an M.Phil. degree or a degree considered equivalent to M.Phil. degree of an Indian Institution shall be eligible for admission to the Ph.D programme.

1.5. A degree considered equivalent to M.Phil. degree of an Indian Institution, from a foreign educational institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to Ph.D. programme.

11.6.3. Syllabus for Entrance Test: (Ph.D. English)

This is a test to evaluate, appraise and assess general understanding and comprehension of the students as to research. The proper shall consist of 100 multiple choice questions out of which 50% will be from Research methodology and 50% from subject specific components.

The syllabus for the test is divided in two parts viz. Part A & Part B as elucidated below:

Part –A Research Methodology (English)

a. Practical Criticism

b. Literary Theory and its Application

Part –B English

a. Indian Literature

b. Indian Literature in English Translation

c. British Literature

d. American Literature

e. World Literature in English and English Translation

f. Literary Criticism and Theory

g. Cultural Studies

h. Film Studies

Note: Those who qualify the written Multiple Choice Questions (MCQ) examination would be called for personal interaction/interview for second stage of admission. This stage may also have a written component**.**

11.6.4 Mode of Ph. D. Programme Ph.D. (Sociology):

Full-time

11.6.5 Eligibility (Ph.D. Sociology)

1.1 Candidates seeking admission to the Ph.D. programme should have a Master's Degree in Sociology or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing accrediting or assuring quality and standards of educational institutions.

1.2. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, shall be allowed for those belonging to SC/ST/Differently-Abled (PWD) categories.

1.3. A candidate whose M.Phil. Dissertation has been evaluated but the viva-voce is pending may be admitted to the Ph.D. programme in the same USS.

1.4. Candidates possessing an M.Phil. degree or a degree considered equivalent to M.Phil. degree of an Indian Institution shall be eligible for admission to the Ph.D programme.

1.5. A degree considered equivalent to M.Phil. degree of an Indian Institution, from a foreign educational institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to Ph.D. programme.

11.6.6. Syllabus for Entrance Test (Ph.D. Sociology)

This is a test to evaluate, appraise and assess general understanding and comprehension of the students as to research. The proper shall consist of 100 multiple choice questions out of which 50% will be from Research methodology and 50% from subject specific components.

The syllabus for the test is divided in two parts viz. Part A & Part B as elucidated below:

Part – A Research Methodology (Sociology)

I. Research Methodology: Qualitative and quantitative research methods, Tools of data collection, Sampling techniques and types, Modern research techniques, Bibliography and references.

Part – B Sociology (Subject Specific Test)

II Important sociological thinkers and their contributions and theoretical approaches. Salient features of Indian society: Social problems, social stratification, family and marriage in India, kinship structure, religion, rural and urban societies, folk and urban culture, tribal societies, crime in society, political and economic institutions.

Note: Those who qualify the written Multiple Choice Questions (MCQ) examination would be called for personal interaction/interview for second stage of admission. This stage may also have a written component**.**

11.6.7. Mode of Ph. D. Programme Ph.D. (Economics):

Full Time

1. ELIGIBILITY CRITERIA & ADMISSION PROCEDURE:

I. Candidates for admission to the Ph.D. programme should have a Masters Degree in Economics or any field of Social Sciences or any other related area, provided that the candidate has studied Economics as a subject at the undergraduate or postgraduate level, or a professional degree declared equivalent to the Master's Degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing accrediting or assuring quality and standards of educational institutions.

II. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, shall be allowed for those belonging to SC/ST/Differently-Abled (PWD) categories.

III. A candidate , whose M.Phil. dissertation has been evaluated but viva-voce is pending may be admitted to the Ph.D. programme, provided that the candidate has studied Economics as a subject at the undergraduate or postgraduate level.

IV. Candidates possessing an M.Phil. degree or a degree considered equivalent to M.Phil. degree of an Indian Institution, provided that the candidate has studied Economics as a subject at the undergraduate or postgraduate level.

V. A degree considered equivalent to M.Phil. degree from an Indian Institution, or from a Foreign Educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to Ph.D. programme, provided that the candidate has studied Economics as a subject at the undergraduate or postgraduate level.

2. Admission Procedure:

2.1 The admission to the Ph.D (Economics) programme will be done through an Entrance Test (PET) conducted by the University or any designated agency by the University in the relevant disciplines of study and an interview/ viva-voce, as per the University norms.
2.2 Those students, who have qualified UGC-NET- JRF/ UGC-CSIR NET- JRF or equivalent fellowship holder in Economics or have passed M.Phil. Programme in Economics only, shall be exempt from the written entrance test conducted by the University for Admission to Ph.D. programme. However, they shall have to apply for admission to the University. All other candidates should appear for the written Entrance test (PET).

11.6.8. Syllabus for Entrance Test: Ph.D. (Economics)

This is a test to evaluate, appraise and assess general understanding and comprehension of the students as to research. The proper shall consist of 100 multiple choice questions out of which 50% will be from Research methodology and 50% from subject specific components.

The syllabus for the test is divided in two parts viz. Part A & Part B as elucidated below:

1. **Part- A Economics (Subject Specific Test):**
Applied Micro Economics, Applied Macro Economics, Econometrics, Statistics, Mathematics, Public Finance, Indian Economy, Game Theory, Law and Economics, Health Economics, Financial Economics, Industrial Economics, Behavioral Economics, Management Economics, History of Economic Thought, Environmental Economics

2. **Part – B Research Methodology (Economics):** Research Methodology

This part shall contain MCQ questions with emphasis on economic concepts, economic theories, derivations, graphical analysis, analytical and numerical ability, quantitative and qualitative analysis etc.

Note: Those who qualify the written Multiple Choice Questions (MCQ) examination would be called for personal interaction/interview for second stage of admission. This stage may also have a written component**.**

11.7 University School of Law & Legal Studies

11.7.1. Additional Eligibility Criteria:

LL.M. 2 years/1 year from an Indian/Foreign University recognized as per clause 1 of admission brochure.

11.7.2. Mode of Ph. D. Programme:

Full Time/Part Time

11.7.3. Syllabus for Entrance Test:

This is a test to evaluate, appraise and assess general understanding and comprehension of the students as to Research and Law. The paper shall consist of 100 multiple choice questions out of which 50% will be from Research methodology (more inclination towards legal research) & 50% from Law which is inclusive of recent trends covering core and main stay areas like Constitutional law, Jurisprudence, Intellectual Property Rights, Corporate law, Criminal law etc.

The syllabus for the test is divided in two parts viz. Part A & Part B as elucidated below:

PART – A – Research Methodology

Part A is designed to assess knowledge of the students in area of Research specifically legal Research

Research Methodology and Legal Research: meaning, types, nature, objectives characteristics, Steps involved, tools and techniques for data collection, data interpretation and processing, qualitative and quantitative research, Ethical issues involved, analysis of current trends in legal research, diminishing ethical standards in legal research, inter disciplinary research etc

PART – B – Law (Subject Specific Test)

Part-B is designed to evaluate and examine subject specific knowledge of the candidate in Law:

1. Constitutional Law of India
(a) Preamble
(b) Fundamental Rights and Duties
(c) Directive Principles of State Policy
(d) Parliament
(e) Judiciary
(f) Emergency Provisions
(g) Amendment of the Constitution
(h) Writ Jurisdiction etc.

2. Jurisprudence
(a) Schools
(b) Sources
(c) Personality
(d) Rights & Duties
(e) Concepts of Possession and Ownership
(f) Principles of Liability etc.

3. Other Areas in Law and Contemporary issues :
(Other areas would include, corporate laws, criminal law, IPR, IT/Cyber Laws, personal laws and legal issues of contemporary importance)

11.8 University School of Mass Communication

11.8.1. Additional Eligibility Criteria :

The minimum eligibility for admission shall be a Master's Degree in relevant field or equivalent.

11.8.2. Mode of Ph. D. Programme :

Full Time / Part Time

11.8.3. Syllabus for Entrance Test:

Part – A Research Methodology

1. Research: Definition; Sciences and Research; Characteristics of Scientific Method; Facts, Trends, Perspectives & Ideology; Information, Knowledge & Customized Knowledge

2. Mass Communication Research (MCR): Definition and Need; MCR & Scientific Method

3. Types of Research: Pure & Applied; Descriptive, Correlative, Explanatory & Exploratory; Qualitative & Quantitative

4. Approaches to MCR: Social Science Approach & Critical Theory Approach; Critical Theory ; Role of Theory in Research

5. Evolution of MCR-I: Critical Studies (Chicago School & Frankfurt School) ; Early Content Studies (Gate Keeping, Social Influences, Reporting-Sources Relationship)

6. Evolution of MCR-II: Powerful Effects (Magic Bullet), Limited Effects, Moderate Effects(Knowledge Gap, News gathering/News net), Political Effects (Agenda –setting, Spiral of Silence), Individual Effects (Cultivation Research, Dependency Theory), Contingent Effects; Uses & Gratification Research

7. Qualitative Research Methods: Participant Observation, Textual Analysis, In-depth Interviews, Focus-group Discussion, Case Studies, Ethnography , Historical Analysis , Discourse Analysis

8. Quantitative Research Methods: Experiments, Causation, Survey, Content Analysis

9. Variables: Definition; Converting Concepts into Variables; Types (Independent, Dependent, Extraneous, Intervening; Active & Attribute; Categorical , Continuous, Constant, Dichotomous, Polytomous); Types of Measurement Scales(Nominal, Classificatory, Ordinal/Ranking, Interval & Ratio)

10. Sampling: Definition of Population & Samples, Probability & Non-probability Sampling, Sample size & Sample Errors

11. Statistical Tools: Frequency distribution, Cumulative Frequency, Histogram/bar Chart, Frequency Polygon, Frequency Curve, Normal Curve, Skewness; Mean, Median, Mode; Dispersion, Range, Variance, Standard Deviation; Tests of Significance, T-test, ANOVA, Chi-Square test, Z-Test, F-test; SPSS

12. Impact of Technology on Research, Measuring Web Use, Internet research Tools

13. Research Ethics: Theories & Principles; Plagiarism; Intellectual Property Rights

Part – B Mass Communication (Subject Specific Test)

1. Communication & Mass Communication Process, Models, Theories, Nature, Feature, Types, Terms, Media & Society, Media and development, Media Effect Studies

2. Print Journalism History of journalism in India and World, Profession, Function in society, Role & Responsibility, Ethics , Media Laws, Careers, Function of various professionals in journalism, Self Regulation, Professional Organisations,, Press Commission, Press Council, RNI, IFWJ, NUJ, INS, PTI, UNI etc. News Agencies of world, ABC, Language Newspapers, Print production- lay out , design, use of software in production. Specialized areas in Journalism

3. Broadcasting Origin and growth of Radio and Television in world and India, Committees in broadcasting, Prasar Bharti, IBF, NBA, Broadcast Editors Association, SITE, Radio/TV broadcasting and development.

4. Development Communication Concept, Dominant Paradigms, Alternative theories, Approaches, Development Support Communication, Sustainable Development, Participatory approach. Communication and Development.

5. Integrated Marketing Communication Advertising and Public Relations. ASCI, PRSI, IPRA, Brand Management, Ad and PR agenciesOrganisation, Nature, Function. Account Planning, Copy making, Media Planning, TRP, IRS, BARC, Tools & Technique of PR, Theories applied in Advertising and PR. Advertising & Society. Gender role in Advertising, Effects of advertising, Advertising and youth, women, children.

6. Radio and Television production Grammar of TV & Radio, Production team- role and responsibility, Program formats for Radio and Television, Writing for Radio and Television, Camera, Light, Composition, Visual Language, Cues and commands, Sound, Microphone, sets, use of software in radio/ TV production.

7. Cinema History of Cinema- World and India, Grammar of Cinema, Theories, Process of production, Professions in Cinema.

8. Media organisation and Management Media Management, Ownership pattern, Organisational structure of Print, broadcast media houses, Cinema and TV production houses, Advertising and PR agencies, Issues in media economics, Ethics, Regulation, Influence of Market, Political, Social forces and impact of national and world economy, mergers and acquisitions,

9. Convergent Media Online media, Convergence, Writing and designing for new media, blog, vlog, Web newspaper, magazines, radio, video and cinema.

11.9 University School of Information, Communication & Technology

11.9.1. Additional Eligibility Criteria :

S. No.	Ph.D. Discipline	Eligibility Criteria
1.	Computer Science & Engineer	1. M.Tech. (CSE/Computer Systems) or equivalent with 60% marks/7 CGPA 2. Qualified in CET/*GATE in CS & IT/UGC JRF in Computer Application
2.	Information Technology	1. M.Tech. (IT) or equivalent with 60 % marks/7 CGPA 2. Qualified in CET/*GATE/UGC JRF in Computer Science & IT/Computer Application
3.	Computer Application	1. MCA with 60% marks/7 CGPA 2. Qualified in CET/*GATE/UGC JRF in Computer Science & IT/Computer Application
4.	Electronics & Communication	1. M.Tech. in (ECE/VLSI Design/DC/SP/RF & Microwave) or equivalent with 60% marks/7 CGPA 2. Qualified in CET/*GATE in ECE/UGC JRF in Electronic Science
5.	Mechanical & Automation Engineering	1. M.Tech. in Production Engineering/Design Engineering/Thermal Engineering/Tool Engineering/Robotics & Automation Engineering or equivalent with 60% marks/7 CGPA 2. Qualified in CET 3. *GATE in Mechanical Engineering/Production and Industrial Engineering.

* Valid and Qualified GATE score

Note:

1. In case of M.Tech. in (Information Security/Software Engineering/Cyber Security/software systems/Artificial Intelligence) candidate shall be offered discipline in Ph.D programme based on B.Tech. Degree.

2. In case of candidate having M.Tech. (Robotics & Automation Engineering) degree, candidate can qualify GATE examination based on his/her B.Tech. degree discipline.

11.9.2. Mode of Ph. D. Programme :

Full Time / Part Time

11.9.3. Syllabus for Entrance Test :

Part –A -Research Methodology (Common to CSE/IT/CA/ECE/MAE discipline)

Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.
Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.
Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.
Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.
Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.
Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

Part – B CSE/IT/CA (Subject Specific Test)

Digital Logic Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).
Computer Organization and 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).
Programming and Data Structures Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
Algorithms 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, shortest paths.
Theory of Computation Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undecidability.
Compiler Design Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.
Operating System Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.
Databases ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.
Computer 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.

Part B - Mechanical & Automation Engineering (Subject Specific Test)

Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions. Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.
Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.
Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts. Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.
Fluid Mechanics and Thermal Sciences Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings. Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, StefanBoltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.
Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.
Applications: Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and dual cycles. Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.
Materials, Manufacturing and Industrial Engineering Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials. Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.
Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, design of jigs and fixtures. Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly. Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools. Production Planning and Control:

Forecasting models, aggregate production planning, scheduling, materials requirement planning. Inventory Control: Deterministic models; safety stock inventory control systems. Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

Part – B - Electronics & Communication Engineering (Subject Specific Test)

Networks, Signals and Systems Network 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; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.

Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Electronic Devices Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Analog Circuits Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Digital Circuits Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Control Systems Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Communications Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Electromagnetics Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off

frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

11.10 University School of Medicine and Paramedical Health Sciences

All candidates who have passed M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area from a recognized University even if their degree certificates do not state the percentage of marks in the passing examination shall be eligible to be admitted to the Ph.D. programme of USM&PMHS provided they have at least 55% marks in aggregate in B.D.S. or M.B.B.S. and qualify the PET or meet with the criteria of PET exemption.

S. No.	Name of the Programme	Eligibility for appearing for Entrance Test (PET)	Syllabus for Entrance Test (PET)	Process of Admission
1	**Ph.D. Anatomy**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Human Anatomy: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a

				presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
2.	**Ph.D. Physiology**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Human Physiology: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks

		award of a Masters' degree.		(minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
3.	**Ph.D. Microbiology**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S.	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis;	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D.

		A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.	sampling design; study design; and quantitative techniques. **(ii)Microbiology: 50%**	programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
4.	**Ph.D. Forensic Medicine & Toxicology**	■A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in	**i) Research Methodology: 50%** Elementary statistics including mean,	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-

		aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Forensic Medicine & Toxicology: 50%**	JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for**

				candidates who are exempted from PET The merit list will be based on their performance in the interview.
5.	**Ph.D. Community Medicine**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Community Medicine: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the

				research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
6.	**Ph.D. Anaesthesiology & Critical Care**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Community Medicine: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for

				the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
7.	**Ph.D. Paediatrics**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Paediatrics:**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for**

		shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.	**50%**	**candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
8.	**Ph.D. Obstetrics and Gynaecology**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed.	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for

		Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Obstetrics and Gynaecology: 50%**	admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.

9.	**Ph.D. Radiodiagnosis**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Radiodiagnosis: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area.

				Step 4: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
10.	**Ph.D. Endocrinology**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Endocrinology: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research

				interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
11.	**Ph.D. Plastic & Reconstructive Surgery**	■ A Master's degree or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Plastic & Reconstructive Surgery: 50%**	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET.

		Masters' programme where marks are allocated at the time of award of a Masters' degree.		**Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
12.	**Ph.D. Physiotherapy**	A Master's degree in Physiotherapy or a professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. *A relaxation of 5%*	**(i) Research Methodology: 50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution;	**Candidates who are exempt from writing PET** Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for

		marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.	correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Physiotherapy: 50%**	admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be 50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.
13.	**Ph.D. Orthopaedics**	■ A Master's degree in Orthopaedics or a	**(i) Research Methodology:**	**Candidates who are exempt from writing PET**

		professional degree equivalent to Master's degree in the subject or a related field with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. Or ■ M.D., M.S., M.D.S., D.M., M.Ch. in the field or related area with at least 55% marks in aggregate in B.D.S. or M.B.B.S. *A relaxation of 5% marks {from 55% to 50%} or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/differently-abled categories in a Masters' programme where marks are allocated at the time of award of a Masters' degree.*	**50%** Elementary statistics including mean, median, and mode; standard deviation; normal distribution; Poisson distribution; exponential distribution; correlation; covariance; tests of hypothesis; data analysis; sampling design; study design; and quantitative techniques. **(ii) Orthopaedics: 50%**	Students who qualify the UGC-NET (including JRF)/ UGC-CSIR NET (including JRF)/ GATE/DBT-JRF/ICMR-JRF/or are Teacher fellowship holder or have passed the M. Phil programme, are exempt from the entrance test for admission to Ph.D. programme. They must howe They must however apply for admission to the University, as and when, the University invites application for admission to the Ph.D. programme. **Selection process for candidates who appear for PET** **Step 1**: Eligible candidates will write a MCQ based PET. **Step 2:** A merit list will be drawn of the candidates who score the qualifying marks (minimum 50% for the general category candidates, and 45% for SC/ST candidates) in PET. **Step 3**: From this merit list, candidates shall be called for the interview round, where the candidate will be required to discuss their research interest through a presentation before a duly constituted selection committee. The interview will, among other things evaluate the basic knowledge and aptitude, and competence of the candidate for the proposed work and how the research work will contribute to new or additional knowledge in the area. **Step 4**: The final result will be declared on the basis of cumulative performance in theory and interview. Weightage of marks will be

				50% for PET; 50% for the interview. **Selection process for candidates who are exempted from PET** The merit list will be based on their performance in the interview.

Mode of Ph. D. Programme

Full Time

11.11 Centre for Disaster Management Studies

11.11.1. Additional Eligibility Criteria:

1. Candidates for admission to the Ph.D. Programme shall have a **Master's Degree*** or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing accrediting or assuring quality and standards of educational institutions.
(*Candidates having Master's Degree in Management/ Natural Science/ Social Sciences/ Engineering/ Technology/ Medical/ Law/ and allied field related to Disaster/ Emergency services)

2. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, shall be allowed for those belonging to SC/ST/Differently-abled (PWD) categories.

3. Candidates, who have cleared the M.Phil. course work with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) and successfully completing the M.Phil Degree shall be eligible to proceed to do research work leading to the Ph.D. Degree in an integrated programme.

4. All other Eligibility Conditions and Admission Criteria for admission in Ph.D. will be as per University norms given in Ordinance 12 of the University Act

11.11.2. Mode of Ph. D. Programme:

Full Time/Part Time

11.11.3. Syllabus for Entrance Test:

Part A - Research Methodology

Meaning and Characteristics of Scientific Research: Introduction to research, different methods used in research, research design- functions, exploratory, descriptive, experimental; experimental research design- pre experimental, quasi experimental, true experimental. Statistical research design. Various types of research categories- qualitative, quantitative, experimental, exploratory, empirical. **Hypothesis testing**- Null and alternate hypothesis, steps of hypothesis testing, level of significance, type I and type II error, scale of measurement, questionnaire design. **Sampling**- Meaning and types of Sampling, sampling design, sampling size and sampling error. Types of Sampling – simple random, systematic, stratified, cluster, quota, judgemental samplings. **Interpretation of Data**: Data representation, Collection of data- primary and secondary data collection, data tabulation, organisation and graphical representation of qualitative data – line graph, bar graph, pie chart, histogram, scattered plot. Measure of central tendency, range, dispersion, frequency and distribution. Probability and Non-probability design. **Distributions**- Description of discrete distribution, binomial distribution, Poisson distribution, description of continuous variable, normal distribution, exponential distribution. **Ethics**-Fabrication of data and misrepresentation, plagiarism, IPR issues in research.

Part B – Subject Specific Test

Disasters: Natural & Human Induced Disasters

Types of natural and human induced disasters, Disaster Management Cycle, Disaster Profile of India. **Earthquakes**: Causes and their effects. **Landslides**: Causes, prevention& mitigation, **Avalanches**: Formulation, types, hazard mitigation and management. **Volcano**: Causes, mitigation. **Floods**: Causes, vulnerability, types of floods, impacts of flood, Flood management (Mitigation, Preparedness and Response), Urban floods. **Cyclones and Tsunami**: Difference between cyclone, Typhoon and hurricanes, Causes, characteristics, hazard zonation, factors, hazard potential and impact assessment of cyclones and tsunami, coastal zone management, Early warning system for cyclones and Tsunamis. **Drought**: Causes, vulnerability, types of famines, desserts, and desertification; **Industrial**, chemical and hazardous material disasters; **Forest fires.**

Industry security, Safety and Disaster Risk Reduction

Principles of industrial security management, Security operations management, security basics and principles of security design, Physical security measures security surveillance CCTV, security gadgets; security control room. Industry security and law, emergency management protocol, anti sabotage check, security review & up- gradation, bomb threats & search procedures, explosives & IEDs search procedure;

Disaster Management Governance, Law and Policies - International and National

Legal framework for disaster management in India, Important statues with provisions relevant to Disaster Management: Role of legislations in Disaster Management, Environment Protection Act, 1986.Disaster Management Act 2005. NDMA, NIDM, SDMAs, DDMAs, Nodal Ministry/ Coordination of Response, NDRF, SDRF, Armed forces, CAPFs, Local Fire and Emergency Services, their constitution, role and responsibilities. DM at local level. National Disaster Management Plan,2016, National Disaster Management Policy, 2009.International Initiatives by UN, International Decade for Disaster Risk Reduction, Sendai Framework (2013- 2030).

Fire Risk, Safety and Response

Classification of fire, causes of fire, general provision of fire & life safety as per National Building Code of India, passive fire safety, fire safety rules and building evacuation plans, fire prevention methods and techniques, electric hazard shock and protection.Various types of fire-fighting equipment's personal protective equipment's(PPE), portable fire extinguisher (water, foam, CO2, ABC) and fixed fire installation, fire tenders, automatic sprinkler systems, provision of fire safety measures for LPG, CNG and PNG. NDMA guidelines on scaling, fire safety and prevention, on-site and off-site emergency plans, burn victims and first- aids.

Public health in Disaster Management

Public health and its role in disaster management, epidemiology, public health emergencies in disaster- water borne, vector borne and zoonotic diseases, avian flu, Ebola, dengue etc. hospital preparedness for mass casualty management, critical care facilities, NDMA guidelines for hospital safety, public health emergency and disaster, public health policies and emergent health threats.

Role of information and communication technology

Role of satellite base navigation system in disaster management, Disaster management information system, emergency operation centre, early warning system, HAM radio, GPS application in emergency communication, emergency communication system, remotes sensing and GIS application in disaster management.

11.12 Centre of Excellence in Pharmaceutical Sciences

11.12.1 Additional Eligibility Criteria:

i) Candidates for admission to the Ph.D. programme should have a Master's Degree (M.Sc. in Pharmaceutical Chemistry/Chemistry (with specialization in Organic Chemistry)/Microbiology/ Biochemistry/ Biotechnology or M. Pharm. in Pharmaceutical Chemistry/Pharmacology or M.Sc. (Bioinformatics) or M. Tech. (Bioinformatics/ Biotechnology/ Biochemical Engineering/ Chemical Engineering) or MD/MS in any discipline of clinical/non-clinical Medical Sciences) or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or B.Tech (Biotechnology/ Biochemical Engineering/ Chemical Engineering) with 70% marks or 7.00 CGPA on a 10 point scale or an equivalent degree from a foreign educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing accrediting or assuring quality and standards of educational institutions.
ii) A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, shall be allowed for those belonging to SC/ST/Differently-abled (PWD) categories.

11.12.2 Mode of Ph.D. Programme

Full Time/Part Time

11.12.3. Syllabus for Entrance Test (PET/CET)

Part A - Research Methodology

Scientific Research: Meaning and characteristics of scientific research; Validity in research; Phases or stages in research; various types of research: Quantitative, Qualitative, Experimental, Exploratory, Empirical, Descriptive, Ex-post facto, Case studies. Review of literature: Purpose of the review, Sources of the review, Citing references, Ethical and IPR issues in research.
Data representation: Collection of data, Tabulation, Organization and graphical representation of quantitative data: Line Graphs, Bar Graphs, Pie Charts, Histograms; Probability concept and theories.
Research Ethics: Research honesty and integrity, authorship, acknowledgment and citations, funding agencies and sponsorship, sources of data, sensitive materials and safety, patents & copyright, confidentially and privacy, animal and human rights, environmental laws, scientific misconduct-fabrication of data and misrepresentation, plagiarism.

Part B – Subject Specific Test

Syllabi of subjects taught in the broad areas of Chemistry, Medicinal Chemistry, Pharmaceutical Chemistry, Biological Sciences or other Allied Sciences at Master's level, along with a basic understanding of bioinformatics.

11.13 University School of Education

11.10.1. Additional Eligibility Criteria:

Candidates holding Master's degree or a degree equivalent to Master's degree in Education, that is, Master of Arts (Education), M.Ed. approved by UGC/NCTE with at least 55% marks in aggregate or its equivalent grade "B" in a point scale wherever grading system is followed. A relaxation of 5% marks, from 55% to 50% or an equivalent relaxation in grade shall be allowed for those belonging to SC/ST/Differently–abled categories.

11.10.2. Mode of Ph. D. Programme:

Full Time/Part Time

11.10.3. Syllabus for Entrance Test:

Part – A Research Methodology

Elementary statistics including mean, medium, mode, SD variance, normal distribution, poisson distribution, exponential distribution, correlation, covariance, Educational Research: Meaning, nature, types, scope, and limitations.

- Tests of Hypothesis
- Data Analysis
- Sampling design
- Research design & procedure
- Quantitative techniques
- Interpretation of data

Part – B Subject Specific Test

- Philosophical and sociological perspective of education
- Advance Educational Psychology
- Methodology of Educational Research
- Curriculum & Evaluation
- Educational Management, Planning & Finance
- Teacher Education in India: Growth and Development
- Educational Technology
- Educational Evaluation
- Environmental Education
- Educational Leadership and management
- Educational and Vocational Guidance
- Education for Special Focused Groups
- Language and Communication Technology in Education
- Social Science Education
- Science Education
- Education for Human Rights, Peace, International Understanding and Value Education

11.14 University School of Architecture and Planning (USAP)

11.14.1. Mode of Ph. D. Programme

Part time/Full time

11.14.3. Eligibility Criteria for admission to Doctoral program at USAP

Candidates who have cleared Masters in Architecture/ Planning or equivalent are eligible. Course work with 55% marks in aggregate or its equivalent grade "B" in the UGC point scale (or equivalent grade in a point scale wherever grading system is followed) and successfully completing the Masters in Architecture/ Planning or equivalent degree shall be eligible to proceed to do research work leading to the Ph.D. degree in Architecture and Planning.

11.14.4. Procedure for admission

i) Admission to the Ph.D. program shall be through an Entrance test conducted by the University in the Architecture and Planning disciplines of study.

ii) Reservations shall be as per the University policy, notified by the university from time to time.

iii) The written test shall be the qualifying examination for admission to Ph.D. programme with 50% as qualifying cutoff. The Syllabus of the written entrance test shall consist of 50% Research Methodology and 50% shall be subject specific.

iv) An interview shall be organized where the candidates are required to discuss their research interest/ area through a presentation before a duly constituted Admission committee

v) The admission shall be based on the performance/ merit of the candidate in the interview/ viva voce.

The interview / viva voce shall consider the following aspects:

a) The candidate possesses the basic knowledge and aptitude for the proposed research work

b) The candidate possesses the competence for the proposed research work

c) The proposed plan of research can contribute to new/additional knowledge in the area of research.

For both written entrance test and interview, qualified candidates and fellowship holders (as mentioned above) the merit list (out of 100 marks), for admission will be prepared as per the Ph.D. ordinance 12.

d) The interview/ viva voce shall be conducted by the admission committee of USAP

e) Employed candidates, including permanent faculty members of the university school, affiliated colleges/institutions who wish to seek Ph.D. admission as full time research scholars must obtain leave for a period of at least three years to fulfill the minimum registration period of the University. Candidates who need a proof of selection to obtain leave from their employers may use the selection/ admission list displayed on the university website for this purpose, but admission shall only be granted upon submission of leave sanction letter in original. All employed candidates (full time/ part-time) in regular employment must obtain a "No Objection certificate"

for the purpose of pursuing Ph.D. Programme, the same must be submitted at the time of the interview for admission.

11.14.5. Syllabus for Entrance Examination

1. Part-A will consist of 50 objective type questions and will include research methodology, general awareness/knowledge, reasoning, analytical ability.

2. Part-B will consist of 50 objective questions covering various subjects that an Architect with experience and/or Masters Qualification is expected to know including but not limited to:

a) Research Methods for Architecture, Mathematical Intelligence, Reasoning, Basic Vocabulary of Architects and Planners, Professional and Technical Writing Skills, Presentation skills etc.

b) Professional Practice, Guidelines of Council of Architecture related to professional services, appointment of Architects, Education etc.

c) Provisions of National Building Code, Space Standards, URDPFI guidelines, EIA, Legal provisions related to Health Safety and Environment, Building Regulations.

d) Sustainable Architecture, Energy Efficient Building Designs, Green Building Rating systems in India and abroad, Solar Passive Architecture.

e) Urban Infrastructure, Urban Environmental Services, Urban Transportation, Transport Oriented Design. Major Policies, Mission and schemes of Government of India related to Housing, SMART cities, HRIDAY cities, Swachh Bharat Abhiyan, AMRUT, JNNURM, Slum Upgradation etc.

f) Gender issues in Architecture, Urban Planning, Housing, Urban Transport, Landscape Architecture, Public Realms, etc.

g) General Awareness about Environment, Ecology, Climate Change, Global Warming Sustainable Development Goals, Disaster Management, Natural and Bult Heritage, Urban Economics, etc.

h) Waste Management Technologies, Water Management, Renewable Energy Technologies, Vernacular and traditional solar passive Design of buildings.

i) Contemporary and Traditional examples of sustainable/ energy efficient architecture/settlement planning In India and other parts of the world

j) Basics of Project Management, Construction Management, Real Estate Management, Contemporary Materials and construction technologies, Structural Systems, High Rise and Long Span structures, Project Finance, Contracts, Public Private Partnerships, Participatory Approaches to Development, Community Participation etc. History of Architecture and Human Settlements-Ancient Civilizations.

11.15 Eligibility and admission guidelines for Ph.D. admission of foreign students in University Schools of Study

11.15.1 The foreign students seeking admission to Ph.D programme in the University Schools of Study are required to fill the application form available in this brochure. The scanned copy of the completed application form alongwith all the relevant documents shall be submitted to drc@ipu.ac.in.

11.15.2 The eligibility criteria as applicable for the Indian candidates (as per the ordinance 12 of the University as approved in the 65th Board of Management i.e. 15th June 2017) shall apply to the international students also.

11.15.3 The international students seeking admission to the Ph.D Programmes foreign quota shall necessarily have to clear English proficiency exam (TOEFL or IELTS). TOEFL score 70 or IELTS band 6 shall be required for admission in all Schools other than University School of Humanities and Social Sciences (USHSS). However, TOEFL score 80 or IELTS band 7 shall be required for admission in USHSS. In the case of candidates applying on Indian Council for Cultural Relations (ICCR) Scholarships, the English proficiency score awarded and reported by the Council shall be considered as equivalent to IELTS score.

11.15.4 The candidates (from any foreign country) having completed their qualifying degree from India or a foreign centre of Indian University shall be exempted from the requirement of English Proficiency as mentioned above in 11.15.3.

11.15.5 The English proficiency documents must be submitted along with the Admission Form.

11.15.6 The applications of foreign nationals shall be evaluated on the basis of their synopsis. If the synopsis and other qualifications are found suitable by the concerned school, the application shall be shortlisted and the candidate be interviewed by SRC through video conferencing to test domain knowledge.

11.15.7 International scholars applying for admission to Ph.D Programme of the University shall have the option to indicate the preferred supervisor for their research. However, the allotment of supervisor to the scholar shall be made by the SRC and there is no guarantee that the preferred supervisor shall essentially be allocated to the scholar.