SYLLABUS **SENIOR SCIENTIFIC ASSISTANT** POLYGRAPH DIVISION

1. **Biological basis of Behavior-**
   The Central and Peripheral Nervous Systems–Structure and functions. Methods of Physiological Psychology: Invasive methods–Anatomical methods, degeneration techniques, lesion techniques, chemical methods, microelectrode studies. Non-invasive methods–EEG, Scanning methods. Glandular system: Types and functions, Biological basis of Motivation: Hunger, Thirst, Sleep and Sex. Biological basis of Emotion: The Limbic system, Hormonal regulation ofbehavior.Geneticsandbehavior.

2. **Perception and Learning-**
   Perception: Concept of Perceptual Organization & Illusions, Role of motivation and learningin perception, Learning Process, Fundamental theories: Thorndike, Guthrie, Hull, Classical Conditioning: Procedure, phenomena and related issues, Instrumental learning: Phenomena, Paradigms and theoretical issues; Reinforcement: Basic variables and schedules;

3. **Memory, Forgetting and Thinking-**
   Memory processes: Encoding, Storage, Retrieval, Stages of memory: Sensory memory, Short-term memory (Working memory), Long-term Memory (Declarative – Episodic and Semantic; Procedural), Theories of Forgetting: Interference, Retrieval Failure, Decay, Motivated forgetting. Language and Thought Problem solving: Type, Strategies, and Obstacles, Decision-making.

4. **Intelligence and Personality-**
   Intelligence: Concept & Theories, Determinants of Personality: Biological and Socio-cultural, Approaches to the study of Personality: Psychoanalytical, Neo-Freudian, Sociallearning, Trait and Type, Cognitive, Humanistic, Existential, Transpersonal psychology. Other Theories: Rotter's Locus of Control, Seligman's Explanatory styles, Kohlberg's theoryofMoraldevelopment.

5. **Motivation and Emotion-**
   Basic motivational concepts: Instincts, Needs, Drives, Arousal, Incentives, Motivational Cycle. Approaches to the study of Motivation: Psychoanalytical, Ethological, S-R Cognitive, Humanistic Exploratory behavior and curiosity, Zuckerman's Sensation seeking achievement, affiliation and power, motivational competence, Self-regulation flow. Emotions: Physiological correlates emotion regulation.

6. **Social Psychology-**
   Social perception Attitude and its change within cultural context; Pro social behavior Group and Social influence [Social Facilitation; Social loafing]; Social influence Group dynamics, Theories of intergroup relations, Identity Theory, Relative Deprivation Theory, Realistic Conflict Theory, Balance Theories, Equity Theory, Social Exchange Theory.

7. **Human Development: Stress andCoping-**
   Developmental processes: Nature, Principles, and Factors in development, Stages of Development. Successful aging. Various aspects of development: Sensory-motor, cognitive, language, emotional, social and moral. Conflicts: Sources and types, Stress and Coping: Concept, Models, Type A, B, C, D behaviors, Stress management strategies

8. **Psychopathology and Interventions-**
   Psychopathology: Concept, Classification and Causes, Psychotherapies: Psychoanalysis, Person-centered, Gestalt, Existential, Acceptance-Commitment Therapy, Behavior Therapy, REBT, CBT, MBCT, Play Therapy, Positive psychotherapy, Transactional Analysis, Dialectic behavior Therapy, Art Therapy, Performing Art Therapy, Family Therapy.

9. **Research Methodology-**
   Research: Meaning, Purpose, and Dimensions. Research Problems, Variables and Hypothesis, Sampling. Ethics in conducting and reporting research, Paradigms of research: Quantitative, Qualitative, Mixed methods approach, Methods of Research: Observation, Survey, Experimental.

10. **Psychological Testing-**

Types and Characteristics of Psychological Tests. Ethical Issues in Psychological Testing, Areas of Testing: Intelligence, Neuropsychological tests, Personality assessment, Interestinventories and Attitude Applications of psychological testing in various settings: Clinical & Forensic settings. Forensic Psychology- Definition and scope of Forensic Psychology- Historical perspective; Developmental Theories, Role and responsibility of Forensic Psychologist, Legal Concepts and Evidencerelated Issues, Interrogative techniques, Forensic Psychology in India, Concept of Cyber Psychology: Cyber Pornography, Cyberbullying.

11. **Forensic Psychological Assessment and Investigating Techniques-**
Forensic Psychological Assessment and Crime Investigation Tools, Detection of deception, Methods for detection of deception. Interview and interrogation, Non-verbal detection, Forensic Statement Analysis, Hypnosis Layered Voice Analysis, Psychological Autopsy, Narco-Analysis & Brain – Mapping, Current research in detection of deception/truth finding mechanisms, Eye witness testimony, Impact of Crime on Victim.

12. **Psychological Disorder and Criminal Behavior -**
Concept and theories of Criminal Behavior, Punishment & type of Punishment, Psychology of Aggression & Violence, and Emerging Crime trends in India, Prevention of Crime Juveniledelinquency and cause and prevention. Mentally ill offenders, Psycho-Path offenders, Serialkillers, Criminal Profiling, Crime Scene Profiling, Sex- Offenders, Child Abuse & Domestic Violence, Psychological Profiling of Terrorist, Drug related Crime. Types of Court and role of psychologists – criminal, juvenile, civil & family court, Criminal Competency, Understanding court process and punishment. Requirements from the Investigating Officer, Consent (Article 21(3), Important Judgements (Selvi & Ors vs State of Karnataka, etc), Admissibility of Forensic Report in Court (Section 293Cr. Mental Health and Law Supreme Court Judgment and NHRC Guideline.

13. **Basic of Polygraph-**
Meaning of Polygraph, Physiological Aspects, Psychological Aspects, Sensors of Polygraph, Testing Procedure (Pre–test Interview/ Examination, Proper/ Post Test Interview), Types of Questionnaires (MGQT/POT / Card Test / AffirmativeTest, etc), Polygraph and Autonomic Nervous System, Limitation in Polygraph, False Positive & False Negative.

SYLLABUS FOR SCREENING TEST FOR THE POST OF SENIOR SCIENTIFIC ASSISTANT DNA DIVISION

I- BIOCHEMISTRY -

Introduction to basic concepts, Ionic Equilibrium, Chemistry of bio-molecules, Nucleic acids, Protein
structure, Enzymes, Enzyme kinetics. Carbohydrate metabolism, Lipid metabolism, Nitrogen metabolism, Nucleic acid metabolism,

Bioenergetics and Metabolism:, , Cell bioenergetics: First and second law of thermodynamics, internal energy, enthalpy, entropy, concept of free energy, standard free energy, change of a chemical reaction, redox potentials ATP and high energy phosphate compounds. Electron transport chain and oxidative phosphortylation.

II- MOLECULAR BIOLOGY -

DNA: Chemical composition of DNA, C-value paradox, DNA replication Prokaryotic DNA replication, Eukaryotic-replication, DNA damage, RNAs: types, Genetic Engineering, restriction enzymes, DNA Modifying enzymes, Cloning vectors, Cloning hosts. Post transcriptional processing of RNA: Processing of rRNA, Processing of pre- tRNA, Pre-mRNA processing, Capping and polyadenylation, Splicing, Pre-mRNA Editing, Self splicing introns, Informosomes, mRNA stability and turn over, Genetic code, Prokaryotic Translation, Eukaryotic translation, Translational apparatus, Regulationof protein synthesis, Post translational processing, Processing of Pre-pro-proteins.

Cell signalling: Hormones and their receptors, cell surface receptor, signalling through G-protein coupled preceptors, signal transduction pathways, second messengers, regulation of signalling pathways. Prokaryotic Gene Expression, Regulation of prokaryotic genes expression and operon, Eukaryotic gene expression: DNA binding proteins, Transcription factors (TFs), Eukaryotic RNA polymerase, Characterization of TATA box, Gene expression and Chromosome remodeling, Regulation of gene expression at transcriptional level.

Mammalian systems: Stem cells- Different kinds of stem cells and their characters, transformation into different types, cell types-molecular approach, Bone marrow, multipotent stem cells, Hematopoietic stem cells and their mode of differentiation and development into a variety of circulatory cells. Stem cell engineering, applications and prospects.

Renewal of tissues and tissue engineering: Renewal of cells that are lost in adult tissues such as epidermal cells, mammary gland cells, photoreceptor cells in retina, liver cells. Differentiation and development of muscle cells-embryonic somites to myoblasts, myogenic genes and expression, terminal differentiation of myoblasts.

III- GENETICS -

Mendelism, Extensions of Mendelian principles, Evolution of genes concept, Linkage and chromosomal mapping, Inbreeding depression and Heterosis, sex linkage and sex determination, chromosomal and gene mutations. Population genetics, Quantitative genetics, Evolutionary genetics.

Chromosomal anomalies and Techniques in the study of chromosome and their applications: Short term (lymphocyte) and long term (fibroblast) cultures, chromosome preparations, karyotyping, banding, chromosome labeling. *In situ* hybridization, chromosome painting, comparative genome hybridization (CGH), somatic cell hybrids and gene mapping, premature chromosome condensation.

Variation at the genetic level: DNA markers – VNTR, STR, microsatellite, SNP and their detection techniques – RFLP, genotyping, RAPD, AFLP etc. Construction of DNA libraries, Genome sequencing

Gene expression: Basic processes and Gene regulation and Introduction to Human Genetics: History of early perception, development and documentation; genome organization; Chromosome structure, function and implications for disease.

Study tools in Human Genetics: Human genome mapping methods; Physical mapping: Introduction to physical map markers- Human genome analysis: Conception, mapping cloning and sequencing,

IV- MICROBIOLOGY -

Diversity Of Prokaryotic And Eukaryotic Microbes. Bacteria, Bacterial plasmids, Cyanobacteria, Fungi, Microbial metabolism, Microbial pathogenesis. Medically important bacteria
Archaea, Bacteria, Fungal Systematics and Diversity, Mycorrhizal fungi, Agriculturally important toxigenic fungi, secondary metabolites from fungi, Genomics and Biodiversity of yeast, Antagonistic interactions in yeasts, Biotechnological application of yeasts.

Virology: Animal Viruses Classification, Morphology and Chemistry of Viruses, Working with viruses, Virus replication Strategies, Replication patterns of specific viruses. Pathogenesis of viral infection, Anti-viral strategies prevention and control of viral diseases. Plant and microbial viruses classification, Morphology and Chemistry of Viruses.

V- BIOTECHNOLOGY -

Organization of structure and functions of prokaryotic and eukaryotic cells

(a) Cell wall and cell membrane: physical structure of biological membranes in prokaryotes and

eukaryotes, lipid bilayer, membrane proteins, other constituents, diffusion, osmosis, active transport regulation of intracellular transport and electrical properties. Extracellular matrix and cell-cell interaction,

(b) Structural organization and functions of cell organelles, Cytoskeletons structure and motility function.

(c) Organization of genomes: genes and chromosomes, operon unique and repetitive DNA interrupted genes, gene families structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.

(d) Cell division and cell cycle, Apoptosis, Necrosis and Autophagy.

Recombinant DNA Technology and Applications: Restriction and Modification systems in E. coli and their use in recombinant library constructions. Restriction and Modifications enzymes and their uses. Basic techniques for RDT including Agarose gel electrophoresis, PAGE, Pulse field electrophoresis. Basic Biology of plasmids including their replication, copy number, incompatibility of plasmids and development of Plasmid Vectors. Cloning and expressions vectors. Basic DNA sequencing methods, introduction to Next Generation Sequencing (NGS) Polymerase chain reaction and its application in research. Oligonucleotide synthesis, purification and its application in screening of libraries, cloning and mutagenesis, Synthetic gene assembly.
Strategies for constructing cDNA libraries and screening using Nucleic acid and antibody probes. Subtractive Libraries, Expression based strategies for cloning of functional genes, differential mRNA display. Strategies for constructing Genomic libraries and screening using nucleic acid probes. Understanding of operon Lac, Trp, and their application in studying biological processes and development of vectors. Use of Tags to aid solubility and purification of DNA safety guidelines and regulatory aspects.

VI- IMMUNOLOGY AND PHYSIOLOGY -

Cells and molecules involved in innate and adaptive immunity, antigens, antigencity and immunogenicity B and T cell epitomes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, , antigen- antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Cell-medicated effector functions, inflammation, hypersensitivity and autoimmunity, cancer,. Water and Osmoregulation, Cytoplasmic fluidity, Membrane-Structure and Function. Concept of membrane electrical potential, Cell Receptors, Signal Transduction, Intracellular Membrane and Protein Flow, Fluid Flow Circulation in Humans.

Physiology: Blood and cardiovascular System, Digestive System, Muscular system, Respiratory system, Nervous system, Sense organs, Excretory, Endocrinology and Reproductive system.

VII- TOOLS AND TECHNIQUES -

(a) Biochemical Methods: Chromatography Ion exchange, Gel Filtration and Affinity chromatography. Electrophoresis: Native and SDS-PAGE, Iso electric focusing 2D-PAGE and its applications.

(b) UV/VIS spectrophotometer, Beer-Lambert's law and its use in determination of protein/nucleic acid concentration.

(c) Fluorescence, Spectroscopy: Basic concepts of excitation and emission Quenching, Theory and application of FRET.

(d) Centrifugation: basic concepts of centrifugation. Calculation of g value from RPM. Density gradient centrifugation. Sedimentation velocity and Sedimentation equilibrium, Separation of sub-cellular components and macromolecules using high speed and ultracentrifugation.

(e) Microscopy: Bright field, phase contrast fluorescence, confocal and electron microscopy.

(f) Biostatistics and Computer Applications: Measures of central tendency and dispersion: mean, median range, standard deviation and variance. Correlation and simple linear regression.
Sampling: Sampling techniques, sampling errors, framing Hypothesis, level of significance, tests of significance (F & t test), chi-square test. Computer Oriented statistical techniques. Frequency table of single discrete variable, computation of mean, variance and standard deviation, t-

test correlationcoefficient.

VIII- FORENSIC SCIENCE –

1. Definition and scope of forensic science- History and Development of forensic science, organization of the forensic science laboratory. Central and state forensic science laboratories, Directorate of forensic sciences. Functions of a forensic scientist.
2. Physical Evidence: Their significance, class and individual characteristics, identification and individualization of physical evidence, locards's exchange principle mobile forensic science laboratory and its deployment in scenes of crimes.
3. The scene of Crime: Crime scene search for physical evidence, photography, sketching, collection, preservation, packing and transportation of evidence, maintaining the chain of custody.
4. Types and distribution of body fluids: Blood, blood stains, semen, seminal stains, urine (formation, composition, properties); amniotic fluid, sweat (formation, composition, properties); saliva, vaginal fluid, epithelial cells, etc., their analysis and forensic significance.
5. Wild life DNA analysis and its applications in forensic science.
6. Intellectual Property Rights (IPR) and its importance in DNA profiling with case studies.

Forensic DNA profiling –International, national and state level cases.

24/6/22

निदेशक
राज्य विधि विज्ञान प्रयोगशाला
[illegible], जयपुर

JUNIOR SCIENTIFIC ASSISTANT (Biology/Serology/DNA)

BIOLOGICAL SCIENCES PART-A

जीव विज्ञान (पार्ट–अ)

1. Genetics: Mendel's law, General Terminology, Molecular basic of Heredity, Linkage, mutations and crossing over, Structure of chromosome, sex determination and genetic disorders in human. Human genetics, Hardy Weinberg Law, Variations and Polymorphism.
2. Structure of DNA and RNA, DNA replication, transcription and translation: Genetic Code.
3. Cell theory, cell division, and it's types, Cell structure, cellular organelles and their functions in eukaryotes.
4. General principles of taxonomy; concepts of the five kingdom scheme, Classification of Animal Kingdom: Up to Phyla in Non chordates and up to class in chordates.
5. Digestion, Respiration, Excretion, circulatory and Integumentary system in human, Aerobic and anaerobic respiration, Kreb Cycle, Glycolysis.
6. Endocrine System and immune system of Human: Endocrine Glands and their hormones with mechanism.
7. Nervous system and sensory organs of Human: structure of Brain, Structure of Neuron, Nerve impulse and sensory organs (Eye and Ear),
8. Human skeleton system and Muscular System: Bones, ligament, tendons, joints structure with identification of bone. General characteristics of muscles, type of muscles and Muscle contraction.
9. Reproduction and development in human: Structure, Gametogenesis, Fertilization, Cleavage, Extra-embryonic membranes, placentation in Mammals and Reproductive health, Disease in human caused by Bacteria, Virus, Protozoa, Fungi and Helminthes.
10. Biological Evolution, History of evolutionary thoughts (Lamarckism and Darwinism), Study of Fossils, Dinosaurs, Archaeopteryx.
11. Economic Importance of mammals.

BIOLOGICAL SCIENCES PART-B

जीव विज्ञान (पार्ट–ब)

1. General Characters of: Algae, Fungi, Lichens, Bryophyta, Pteridophyta, Gymnosperms and Angiosperm. Economic importance of narcotic plants.
2. General study of Bacteria and Virus.
3. Plant anatomy of Angiosperm: Stem and Leaf, flower, seed and Root.
4. Plant Physiology: Osmosis, water Absorption, Ascent of sap, transpiration. Photosynthesis, Respiration, Plant growth and movement.
5. Environmental Studies: Structure and type of Ecosystem, Energy flow, Biogeo-Chemical Cycle (Nitrogen, Carbon and Phosphorus), Ecological Adaptations, Environmental Pollution, Population Ecology, Biodiversity, Wild life in India.
6. Biotechnology: general account, Recombinant DNA technology, transgenic plants and animal, Ethical issues, Application of biotechnology in Agriculture and medical field.
7. Tools and Techniques: Electrophoresis, PAGE, SDS-PAGE agarose gel electrophoresis, Iso-electric focusing, Capillary electrophoresis. Visualizing proteins and DNA, Microscopy: principles and different types of microscopes and its forensic applications.
8. Properties, classification and functions of carbohydrates, proteins, nucleic acids and lipids.

9. Nucleic Acids: Structure and functions, isolation of DNA from biological sources Types of DNA and their role in human identification, DNA profiling: History of DNA typing Physiochemical properties of nucleic acids, melting of DNA (Tm); factors affecting Tm, Chemical reactions of DNA and RNA.

10. Extraction of DNA from different types of biological samples, DNA extraction methods, Determining quality and quantity of DNA samples, contamination issues.

11. DNA amplification: Principle, Methodology, types of Polymerase Chain Reaction (PCR), PCR inhibitors and solutions, primers applications of PCR in forensic science.

12. Sequencing of DNA: Sanger Sequencing Method, Maxam Gilbert method. Chargaff's rule, secondary structure of DNA. Watson and Crick model, palindrome sequences.

भाग–ब :–भौतिक(PHYSICS), **Junior Scientific Assistant**

1. **Mechanics:** S.I. units, motion in one and two dimensions, Newton's law of motion with applications. Frictional forces, Work, Power and Energy. Concept of particle, rigid body, force, mass, weight, scalar and vector quantities, Vector algebra, Simple harmonic motion, projectile motion, circular motion, motion under central forces (inverse square law) escape velocity. Conservative and non-conservative systems. Collisions, Conservation of energy. Linear and angular momentum. Rotational kinetics, Rotational dynamics. Artificial satellites. Surface tension and Viscosity, streamline and turbulent motion. Stoke's law and its application, special theory of relativity, Mass energy equivalence.
2. Thermodynamics: Zeroth, First & Second Law of thermodynamics, Thermodynamic Processes, heat engines and refrigerators, Carnot Cycle.
3. Oscillations and Waves: Simple harmonic motion & its example. Resonance Principle of super-position of waves, Doppler Effect, Damped Oscillations and Waves – propagating, standing waves and their properties and applications.
4. Electrostatics and Electromagnetism: Coulomb's Law, electric field gauss's theorem & its application. Electrostatic potential and Potential Energy, Magnetic Field, Ampere's Law, Bio-Savart Law, Electromagnetic Wave, Maxwell Equation.
5. Electronics: Electric Current, Basics of LR, CR, LCR Circuits, Kirchhoff's law, Wheatstone-bridge, Transistor Oscillator, Op-Amp, Boolean Algebra, Logic Circuits and Logic Gates.
6. Optics: Reflection, Refraction of light, microscope & telescope, interference, diffraction, polarization, Laser and Holography.
7. Quantum Mechanics: Black Body Emission, Photoelectric Effect, Compton Effect, De-Broglie Hypothesis, Heisenberg Uncertainty Principle, Quantum Operator, Schrodinger Equations and its applications.
8. Atomic and Molecular Spectroscopy: Energy Levels, Absorption and Emission Spectroscopy, Molecular Spectroscopy and their applications.
9. Nuclear Physics : properties of Nucleus, Nuclear models, Mass defect, nuclear binding energy, Radio-active Decays, nuclear fission & fusion, nuclear reaction, Alpha, Beta and Gamma radiation and Decay, Radiation detectors, particle accelerators, Elementary Particles.
10. Solid State Physics: Solid State Structure and Crystallography, X-ray and Neutron crystallographic study, Free Electrons in metals and Electronic states of crystals.
11. Collision of gases, mean free path, wall collision and rate of effusion, viscosity of gases, viscosity coefficients, effect of temperature on viscosity coefficient, Diffusion, Elasticity and Fluid Dynamics.

भाग–ब :–अस्त्रक्षेप(**Ballistics**) **Junior Scientific Assistant**

1. **Modern physics:**Bohr's Theory of Hydrogen atom, Optical and X- ray spectra, Photoelectric effect, Compton effect, Wave nature of matter and Wave-particle duality, Natural and artificial radio-activity, alpha, beta and gamma radiation , chain decay, Nuclear fission and fusion. Elementary particles and their classification.

2. **Waves and Oscillations:** Simple harmonic motion, Travelling and stationary waves, Super postion of waves, Beats, Forced oscillations, Damped oscillations, Resonance, Sound waves, Vibrations of air columns, strings and rods. Ultrasonic waves and their application. Doppler effect.

3. **Optics:** Thin lens formulae, Systems of two thin lenses, Optical instruments, Eyepieces, Nature and propagation of light, Interference, Division of amplitude, Simple interferometers. Diffraction- Fraunhofer and Fresnel, Grating. Resolving power of optical instruments . Polarization, Production and Detection of Polarized light. Lasers and their applications.

4. **Mechanics:**S.I. units, motion in one and two dimensions, Newton's law of motion with applications. Frictional forces, Work, Power and Energy. Concept of particle, rigid body, force, mass, weight, scalar and vector quantities, Vector algebra, Simple harmonic motion, projectile motion, circular motion, motion under central forces (inverse square law) escape velocity

Conservative and non-conservative systems. Collisions, Conservation of energy. Linear and angular momentum. Rotational kinetics, Rotational dynamics. Artificial satellites. Surface tension and Viscosity, streamline and turbulent motion. Stoke's law and its application, special theory of relativity, Mass energy equivalence.

5. **Thermal Physics:** Law of thermodynamics, Heat engines, Thermodynamic potentials and Maxwell's relations. Vander wall's equation of state , Joule- Thomoson effect. Phase transition, heat conduction and specific heat in solids, Kinetic theory of Gases, Ideal gas equation, Equipartition of energy, Means free path, Brownian motion, Black-body radiation Planck's law.

6. **Atomic and Molecular Spectroscopy:** Energy Levels, Absorption and Emission Spectroscopy, Molecular Spectroscopy and their applications.

7. **Geometry :** Analytic Geometry of straight lines referred to Cartesian and polar Coordinates; three dimensional geometry of planes, straight lines, sphere and cone.

8. **Calculus :** Real numbers order completeness property, standard functions, limits, continuity properties of continuous functions in closed intervals, differentiability Mean value theorem, Taylor theorm, Maxima and Minima, application to curves tangent normal properties, Curvature, double points. Definition of a definite integral of continuous function as the limit of a sum, fundamental theorem of integral calculus, methods of integration, volume and surface of solids of revolution. Partial differentiation and its application. Alternating series and absolute convergence.

9. **Differential Equations:** First order differential equations, singular solutions, geometrical interpretations, liner differential equation with constant coefficients.

10. **Algebra:** Sets, relations, equivalence relations, natural numbers, rational numbers, real and complex number, division algorithm, derivations, integral, rational real and complex roots of a polynomial, relation between roots and Coefficients, elementary symmetric functions, Groups, fields and their elementary properties

11. **Chemical equalibria and Chemical Kinetics**- Law of mass action and its application to homogeneous and heterogeneous equilibrium; Le Chatelier principle and its application to chemical equilibria.Kinetic theory of gases and gas laws. Maxwell's law of distribution of velocities. Vander vaals equation. Law of corresponding states. Specific heat of gases, ration C_p/C_v.

12. **Alkanes, Alkenes and Alkynes** - simple derivatives of aliphatic compounds; halides, alcohols, aldehydes, ketones, acids, amines and nitro compounds; monohydroxy, ketonic and amino acids.Homogeneous and heterogeneous catalysis. Promoters and poisons.

13. Basic principles underlying spectral techniques (UV-visible, IR, Raman and NMR). Atomic number, electronic configuration of elements, Aufbau's principal, Pauli's exclusion principle, salient characteristics of 's', 'p', 'd' and 'f' block elements.

14. Natural and artificial radioactivity theory of nuclear disintegration; nuclear bindings, energy, nuclear reaction fission and fusion radioactivity Isotopes and their uses.

15. Chemistry of common elements and their compounds, treated from the point of view of periodic classification.Principles of extraction of metals, as illustrated by sodium, copper,, aluminum, iron and nickel.Common ion effect, solubility products and their applications in qualitative inorganic analysis.

भाग–ब :–साईबरफॉरेंसिक (**Cyber Forensic**) , **Junior Scientific Assistant**

1 Computer Fundamental

Computer System History and development, Computer Organization and Architecture: Machine instructions and addressing modes, ALU and data-path, CPU control design, Cache memory. Types of Buses in Computer Architecture, Primary and Secondary Storage devices, Input- Output device, Type of Secondary Storage Device (HDD (SATA, PATA, IDE, SCSI SAS), SSD (SATA, M.2, PCI &NVMe), External storage devices: Flashdrive, Memory card, CD/DVD.
Digital Computer Principles: Number systems- Binary, Decimal, Octal, and Hexadecimal and their Conversion.

2. Operating system and File System-

Operating system, layered architecture/logical structure of operating system, Types of OS, virtual machine, OS services, BIOS, Firmware- BIOS, Boot Strap Loader. Process management, Memory management, Virtual Memory.overview of operating system in Linux & windows.

File System concepts, naming, attributes, operations, types, structure, file organization & access (Sequential, Direct, Index Sequential) methods, memory mapped files, directory structures-, overview of file system in Linux & windows.

3. Computer Network and Internet concepts

Introduction of computer networks, Network architecture, configuring network, networks types. LAN, MAN and WAN -Basic concepts, Line configuration, wired topology, transmission mode, VPN, peer-to-peer(P2P) and Internet.Basic concept of hubs, switches, gateways and routers.

Introduction to TCP/IP Model, compare TCP/IP to (OSI) reference model, Network protocol: FTP, Telnet, DNS, DHCP, SNMP, SMTP, POP3 etc. Basic Mobile communication network Model, Wi-Fi network, Bluetooth, Broadband and optical fibre.

Concept of IP address and their version IPv4 and IPv6, Web Hosting Concepts and Domain name Registration Process.

4. Information System Security and Cryptography

Cryptographic System, Classification of Cryptographic System, Substitution-Permutation Network, Feistel structure, Block Ciphers: DES, Double DES, AES, Stream Ciphers: LFSR, RC4.
Public Key Cryptography, RSA, Discrete Logarithm Problems, Diffie-Hellman, DSA, PKI.
Data Integrity, Hash Functions: MD5, SHA, Message Authentication Codes.
Emerging Application: Email Security, SSL/TLS, Web Security, Access Controls, Malwares, Firewalls, and Intruders. Digital Signature, User authentication - Token based, Biometric, Remote user authentication, Intrusion detection systems, honey pots, Denial of Service

5. Foundation to Multimedia Sciences and their Basic

Introduction to digital signals: audio, image and video; Digitization process: sampling and quantization; Image Enhancement Techniques: Spatial and frequency domain; Image Compression Techniques: Introduction, lossy and lossless compression, Run length coding, scalar and vector quantization, JPEG and JPEG 2000 compression techniques; Image description and representation techniques: Introduction, boundary descriptor: chain code and shape number, regional descriptor: color and texture descriptors ; Introduction to pattern clustering and classification.
Basics of Multimedia; Devices for capturing image and video: digital camera and its components, acquisition process of digital image and video; Standards for video transmission; NTSC and PAL.

6. Modern Digital devices and Digital Technologies

Modern digital Devices: Computer, Laptop, tablet, Mobile Phones, POS, ATM machine, Smart watch, Drone, IoT devices.

Crypto Currency, Blockchain Technologies, Cloud computing, Artificial Intelligence, Deep fake video technology, Dark Web, Anonymous browsing techniques.

7. Cyber Crimes & IT Act:
Cyber space, cyber-crimes and types of cyber-crimes Social media-use and misuse, hacking, unauthorized access, spoofing, phishing, cyber terrorism, cyber stalking, social engineering, DOS and DDOS attack, skimming, financial crimes, identity theft, Trojans, viruses, logic bombs, malware attack.
The Information technology Act 2000 and its amendments.Related and relevant section of IPC, Indian Evidence Act, Indian Telegraph Act.
Search, seizure and Collection of digital evidence, Significance of hash value, chain of custody.

8. Mobile forensics and Mobile technology: history of mobile phones, types of mobile phones, basics of mobile phones and their components, identification of mobile phones, operating systems.

Mobile phone technology: e.g. asynchronous transfer mode (ATM), wireless applications protocols (WAP), advanced mobile phone system (AMPS), time division multiple access (TDMA), Code Division Multiple Access (CDMA) cellular networks: GSM, GPRS, EDGE, UMTS, LTE, VoLTE.

Mobile phone data acquisition by manual, logical, file system extraction and physical, Advanced Acquisition techniques. Overview of mobile forensic software.

9. Computer forensics and DVR Forensic: basics of computer forensics, acquisition methods, image format (Raw, DD, SMART, AFF, E01 etc.), disk and file encryption techniques, file signature analysis, windows registry analysis, artifacts recognition from slack space and unallocated space, metadata analysis.

Basics of DVR and NVR, Types of CCTV camera and their characteristics, Operating Systems, enhancement of video and Authentication of video.

Overview of Computer and DVR forensics software and tools: write blockers, imaging, and cloning devices.

10. Network Forensics and Cloud Forensics: introduction to cloud technology, secure cloud bases services, Cloud based Applications: Facebook, Instagram, Telegram, WhatsApp, Facebook Messenger.

Monitoring computer networks and activities, live packet capturing, network intrusion detection, Types of Network Attack. searching and collection of digital evidence from the network.

Cell Site Analysis, CDR Analysis, Tower Dump, IP tracing, web domains analysis, IPDR Analysis, Mobile Phone tracing, Email Tracing.

भाग–ब :–पॉलीग्राफ **(Polygraph) Junior Scientific Assistant**

Unit-I

Psychology as Science, HistoricalBackground, originandDevelopmentofPsychology, Nature and scope of Psychology: Psychology as a Science of Behaviour,Methods of Psychology, Fields of Psychology.

Unit-II

Emotion: Nature of emotion; autonomic, expressive and cognitive components. Theories of emotion: James-Lange, Cannon-Bard, Schachter-Singer and Lazarus. Nature of Emotional Experience, Physiological changes in Emotions, Role of Autonomic Nervous system in Emotion, Theories of Emotion.

Unit-III

Culture and emotion: Similarities and differences in emotions; physiological arousal and evaluations, experience and expression of emotions; emotion and judgment.

Unit- IV

Physiology Psychology,Peripheral, Central and Autonomic Nervous System and Endocrine Glands: Its Function. Foundations of Neurophysiology: Structure and functions of nerve cells and glial cells, nerve impulse and synaptic transmission.

Unit- V

Introduction and Socialization: (a) Introduction: Nature, Fields and Applications, Methods of Social Psychology. (b) Socialization and Social Learning: Nature and Determinants of Socialization. Social learning.

Unit VI

Psychology Applied to Crime Understanding: Introduction to crime, causes of crime. Causes of crimes in India; Juvenile delinquency: Introduction to Juvenile delinquency causes: measures for reforming juvenile delinquents. Crime detection: Association reaction method, Polygraph (lie-detector) method, autonomic changes in emotions, respiratory responses, psychogalvanic responses, blood pressure and brain waves.

Unit-VII

Clinical Psychology: Historical development, nature and scope. Diagnosis: Meaning and nature, differential diagnosis.

Unit-XI

Introduction to Forensic Psychology: Historical overview, Functions of Forensic Psychologists, Psychology and law.

Psychology of Crime: Developmental Theories and Psychobiological bases of crime, Risk Assessment & Violence Prediction, Eyewitness Testimony and Expert Testimony.

JUNIOR SCIENTIFIC ASSISTANT (Chemistry /Arson/Narcotics/ Toxicology)

1. Periodic Table & Atomic Properties: Fundamental particles of an atom (electron, proton, neutron), Rutherford's nuclear model, Quantum Nos., Pauli's exclusion principle, Afbau principle, Types of orbital (s,p,d,f), shape of orbital, Hund's rule, Modern periodic table, Variation in atomic properties (Size, lonisation potential, Electron affinity, Electronegativity).

2. s-Block & p-Block Elements: General introduction, Electronic configuration, Occurrence, Oxidation states, Trends in Physical & Chemical properties, Inert pair effect.

3. Chemical Equilibrium: Factors affecting Equilibrium, Reversible and Irreversible reactions, Laws of chemical Equilibrium, Le Chatelier's Principle.

4. Ionic Equilibrium, acid base equilibrium, pH value, common ion effect, buffer solutions, Acid base titration, Phenolpthalein indicator and chemistry of colour change.

5. Gaseous State: Properties, Boyles's Law, Charle's Law, Avogadro's Law, Dalton's Law, Ideal gas equation, Graham's Law of diffusion, Kinetic theory of gases.
Liquid State: Properties of Liquids, Vapour pressure, Surface tension, Viscosity.

6. Solid State: Properties of Solids, Classification of solids, Unit cells & their types, Packing of crystals, Structure of simple ionic compound, Defects in crystals (Frenkel, Schottky).

7. Solutions: Solute, Solvent, Solution, Concentration of solutions (Molarity, Normality, Formality, Molality, Mole fraction, Weigh percent), Types of solutions (Gas solutions, Liquid solutions, Solid Solutions), Raoult's Law, Ideal & Non-Ideal solutions, Colligative properties of solutions.

8. Nomenclature & General Properties of Organic Compounds: Rules of IUPAC nomenclature, Types of reactions (Substitution, Addition, Elimination), Electrophiles, Nucleophiles, Inductive effect, Electromeric effect, Resonance, Hyperconjugation, Steric effect, Isomerism (Structural & Stereo).

9. Hydrocarbons and their derivatives (Preparation, Physical Properties & Chemical Properties): Alcohols, Phenols, Ethers & Epoxides, Aldehydes & Ketones, Carboxylic acids and Organic compounds of Nitrogen.

10. Chemistry(Preparation, Physical Properties & Chemical Properties)of Carbohydrates, Fertilizers, Paints, Dyes,Fats and Oils.

11. Petroleum Hydrocarbons: Composition, commercial use of different petroleum fractions, their separation and analysis techniques.

12. Basic Concepts of Analytical Chemistry : Different type of units, conversion between units, Significant figures, Types of errors, Accuracy and Precision, Absolute and relative uncertainty, operation and theory of the analytical balance, use of common laboratory apparatus, Primary & secondary standard solutions, General steps in chemical analysis, Safety with chemicals and hazardous waste.

13. Chromatography:Classification of chromatographic methods, Principle of differential migration, Distribution coefficients, Rf factor, Theory and applications of Paper, Column, Thin Layer, Ion Exchange, Gas- Liquid Chromatography. Basic knowledge of modern techniques – HPLC, HPTLC and GC- Head space.

14. Spectroscopy : Electromagnetic radiation, Regions of the spectrum, statement of the Born-Oppenheimer approximation, Degrees of freedom, Basic principle & applications of different techniques; UV- VIS, IR, NMR, Raman, X-ray Fluorescence spectrometry (XRF), Mass Spectrometry and GC-Mass Spectrometry.

15. Forensic Chemistry andToxicology

Explosives: Classification, Composition and characteristics of explosives, Pyrotechnics & IEDs. Chemistry of Fire, Flash point, Fire point and Seat of Fire.
Poisons : Definition, Classification, Toxicological exhibits in poisoning cases, their collection and preservation. Extraction and isolation of poisons from biological specimens.

Detection of Cations and Anions.

Detection of poisonous gases: Phosphine, CO, NH_3, H_2S .

Analysis of Corrosives, Irritants and various plant poisons.

Analysis of Narcotic drugs and Psychotropic substances: Extraction methods and detection of Cocaine, Cannabis, Barbiturates, Benzodiazepines, Amphetamines and Opiates using chemical and instrumental techniques.

Analysis of beverages: Alcoholic and non alcoholic beverages and their composition, Analysis of Ethanol, Furfural, Organic acids, Aldehydes, Chloral hydrate and Methanolusing chemical and instrumental methods.

JUNIOR SCIENTIFIC ASSISTANT (Documents)

1. Modern Physics: Bohr's Theory of Hydrogen atom, Optical and X-ray spectra, Photoelectric effect. Compton effect, Wave nature of matter and Wave-Particle duality.

2. Electronics: Vacuum tubes-diode and triode, p-and n-type materials, p-n diodes and transistors, Circuits for rectification, amplification and oscillations. Logic gates.

3. Electricity and Magnetism: Electric charge, Fields and Potentials, Coulomb's Law, Gauss Law, Capacitance, Dielectrics. Ohm's Law, Kirchhoff's Laws, Magnetic field, Ampere's Law, Faraday's Law of electromagnetic induction, Lenz's Law, Alternating currents, LCR Circuits, Series & Parallel resonance, Q-factor, Electromagnetic Waves, Motion of charged particles in electric and magnetic fields. Particle accelerators, Cyclotron, Betatron, Mass spectrometer, Hall effect. Dia, Para and ferro magnetism.

4. Wave & Oscillations: Simple harmonic motion, Travelling & Stationary waves, Super position of waves, Beats, Forced oscillations, Damped oscillations, Resonance, Sound waves, Vibrations of air columns, strings and rods. Ultrasonic waves and their application. Doppler effect.

5. Optics: Thin lens formulae, Systems of two thin lenses, Optical instruments, Eyepieces, Nature and propagation of Light, Interference, Division of amplitude, Simple interferometers. Diffraction - Fraunhofer and Fresnel, Gratings. Resolving power of optical instruments. Polarization, Production and Detection of Polarized light. Lasers and their applications.

6. Mechanics: S.I. units, Motion in one and two dimensions. Newton's laws of motion with applications, Frictional forces, Work, Power and Energy. Conservative and non-conservative systems. Collisions, Conservation of energy. Linear and angular momenta. Rotational kinematics, Rotational dynamics. Artificial Satellites. Surface tension and Viscosity. Streamline and turbulent motion. Stoke's law and its application, Special theory of relativity, Mass Energy equivalence. Concept of particle, rigid body, force, mass, weight, scalar and vector quantities, Vector Algebra, projectile, circular motion, motion under central forces (inverse square law), escape velocity.

7. Thermal Physics: Laws of thermodynamics, Heat engines, Thermodynamic potentials and Maxwell's relations. Vander wall's equation of State, Joule-Thompson effect, Phase transition, heat conduction and specific heat in solids, Kinetic Theory of Gases, Ideal Gas equation, Equipartition of Energy, Mean free path, Brownian Motion, Black-body radiation Planck's Law.

8. Kinetics: Kinetic theory of gases and gas laws. Maxwell's law of distribution of velocities. Vander waals equation. Law of corresponding states. Specific heat of gases, ration Cp/Cv.

9. Thermodynamics: The first law of thermodynamics. Isothermal and adiabatic expansions. Heat capacities and thermo chemistry. Heats of reaction. Bond energies. Kirchhoff's equation. Criteria for spontaneous changes, Second law of thermodynamics. Free energy.

10. Chemical equilibria: Criteria for chemical equilibrium, Law of mass action and its application to homogeneous and heterogeneous equilibria; Le Chatelier's principle and its application to chemical equilibria.

11. Chemical Kinetics: Molecularity and order of a reaction. First order and second order reactions. Temperature coefficient and energy of activation. Collision theory of reaction rates.

12. Electrochemistry: Faraday's laws of electrolysis, conductivity of an electrolyte. Equivalent conductivity and its variation with dilution. Solubility of sparingly soluble salts. Electrolytic dissociation. Ostwald's dilution law. Solubility product. Strength of acids and bases. Hydrolysis of salts. Hydrogen ion concentration. Buffer action. Theory of indicators.

13. Organic chemistry: Alkenes, alkenes and alkynes- simple derivatives of aliphatic compounds; halides, alcohols, aldehydes, ketones, acids, amines and nitro compounds; monohydroxy, ketonic and amino acids. Benzene and common monofunctionalbenzenenoid compounds, concept of aromaticity as applied to benzene, naphthalene and pyrole-orientation influence in aromatic substitution-chemistry and uses of diazonium salts. Dyes and pigments.

14. Atomic properties: Atomic number, Chemistry of common elements and their compounds, periodic classification. Electronic configuration of elements, Aufbau principle, Pauli's Exclusion Principle, salient characteristics of's', 'p','d' and 'f' block elements. Natural and artificial radio-activity, alpha, beta and gamma radiation, chain decay, theory of nuclear disintegration; nuclear bindings, energy, nuclear reaction, fission and fusion, radioactive isotopes and their uses. Principles of extraction of metals, as illustrated by sodium, copper, aluminium, iron and nickel.

15. Chromatography: Techniques, General Principles of paper, column, TLC, adsorption, partition, Gas, Gas-liquid, Ion exchange, Exclusion (permeation), affinity, HPLC, HPTLC, Capillary etc.

16. Spectroscopy: Principles, Technique, Instrumentation and Applications of Mass Spectrometry, GC-MS-HS, Raman Spectroscopy, N.M.R., UV-Visible, IR Spectroscopy, Fluorescence, X-ray fluorescence spectrometry (XRF).

17. Computer: Components of Computer System, Elementary Computer Applications, Information Technology.

18. Forensic Science: History and basic principles of forensic science, divisions of forensic science, chemical and physical scientific techniques for forensic examinations, legal aspects of forensic science.

SYALLABUS FOR POST JUNIOR SCIENTIFIC ASSISTANT (PHOTO DIVISION)

Introduction of Photography, Defintion of photography, Basic principle in conventional and Digital photography, Basic Camera, different parts of camera and their basic camera accessories.

History of photography, early experiments and later development, optics, light character, lenses- normal, wide, zoom, tele, Macro, fish eye, aperture function, shutter function, focusing, exposures, colour filters, different kind of photography, light sources, natural and artificial, UV. IR transmitted photography, flash digital imaging, sensors, light room, photoshop. Photo tools, photo corrections, portrait photography, basic light system. Soft boxes, snoot doors, photographing in available light, closeup, accessories and techniques.

Terminology of photography, Ambient light, camera angles, captures, colour correction, exposure, F-stop, Lens speed, Resolutions, Shutter speed, Focal length, focus, angle of view, aperture, aperture priority, background, backlight (silhouette effect), bounce lighting, candid picture, CCD sensor, Close up, Close up lens, Depth of field, Diffuse lighting, Digital Zoom, Double exposure, Hot shoe, Lens Shade, Macro Lens, Optical Zoom, Overexpose, Underexpose, Panoroma, Shutter and Shutter speed, Telephoto lens, Time exposure, Transparency, Vignetting, White balance, contrast, Micro and macro photography, depth of field, photographing a subject with different lenses, photography use of a bounce and reflected lights, group photos and arrangement, crime scene photography, use of colours fitters- lighting and effects, selection of shots.

Types of camera, classification of cameras on the basis of image size, focusing arrangement, viewfinder systems and general usage. 35 mm compact, 35mm SLR, digital SLR, instant (Polaroid) cameras, large format cameras and various digital cameras, similarities between digital and analogue cameras.

Understand different file formats RAW, TIFF, JPEG, MPEG printing resolution, forensic photography of biological, documents, trace, moulds, physical evidence photography. Association of linkage the locard exchange principle, transfer of evidence by contact, disproving /supporting, victim/ suspect/ writness statements, Identification of suspects/victims/crime scene location and movie cameras, typically using a lens with variable diaphragm to focus light on to an image. Capture format pixel count, digital file.

Processing digital print. Advantage and disadvantages of digital and analogue camera. Memory card, image sensor, type of digital cameras, additional features, include GPS, compass, barometers and altimeters, 3D photo, action camera, 360 degree cumetas, Image data storage, memory stick SD card, thermography, thermal photography, CD, computer components, computer applications, word processing, data sheet, power point presentation, photoshop etc.

Different type of CCTV camera as dome, Bullet, C-mount, Day/Night/infrared/Night Vision, Network/IP, Wireless and high Defintion HD CCTV Camera with DVR system. Examination of CCTV footages and enhancements.

Instruments- Experiments and result regarding digital SLR camera and videography in visible and invisible spectrum, technical elements in photography and manipulation in photography detection and safeguard.

Photographic light source and its advantage and disadvantages:-
Ultraviolet Light, Infrared Light, Oblique Light, Laser Light, Transmitted Light, X-rays, Beta rays, Spot light.

24/6/22
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राज्य विधि विज्ञान प्रयोगशाला
राजस्थान, जयपुर