RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER BIOLOGY DIVISION (M.Sc. ZOOLOGY) STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

UNIT-I

CELL STRUCTURE, MOLECULES AND THEIR INTERACTION:

- Structural organization and functions of cell organelles: Plasma membrane, intracellular organelles (Nucleus, Mitochondria, Golgi-bodies, Lysosomes, Endoplasmic reticulum, Peroxysomes) and types and structure of Chromosomes
- pH, buffer and buffer system.
- Bio-molecules-Structure, composition and function (carbohydrates, lipids, proteins and nucleic acids)
- Enzymes- types and their functions, regulation, enzyme inhibition, iso-enzymes.
- Structure and Functions of nucleic acids, Processes of DNA Replication, Transcription and Translation.
- Cell division and cell cycle in eukaryotic organisms.

UNIT-II

HUMAN ANATOMY AND PHYSIOLOGY:

- Tissues of body: epithelia and glands, their classification and functions, connective tissues, cartilage- structure and types,
- Bones- formation, gross structure, fracture and healing, Structure and growth of teeth, types, dentition-pattern and formula, eruption sequence and age determination, dental anomalies and their significance in personal identification, bite marks of human/animals and their analysis.
- Structure and functions of major organ systems and their physiology- Integumentary, digestive, skeleton, respiratory, endocrine, nervous, cardiovascular, excretory, reproductive, muscular and neuromuscular systems, blood physiology.

UNIT-III

ECOLOGY, ENVIRONMENT AND MICROBIOLOGY:

- Ecosystem and their types, ecological factors, types of pollution,

- Types of waste, BOD, COD, effect on human health, algal blooms and identification and composition, eutrophication and their effects.
- Various types of planktons and diatoms. Diatom tests and its importance in drowning cases, precautions in collection, preservation and forwarding of biological samples for diatom test, methods of isolation of diatoms from different body tissues/bone marrow and water samples.
- Isolation and classification of various microbes from soil, water and food. Cell structure of bacteria and fungi, spores.

UNIT IV

ANIMAL CLASSIFICATION AND BASIC GENETICS:

- Chemotaxonomy, Cytotaxonomy, Molecular Taxonomy and General classification of Animals (classification of Invertebrates up to order, classification of chordates up to class)
- Mendelian and non-mendelian inheritance, linkage, recombination and crossing over, chromosomal basis of inheritance, sex linked inheritance, chromosomal aberration.

UNIT- V

FORENSIC TECHNIQUES: ANTHROPOLOGY

- Anatomical description of skeletons of human and animals as relevant to forensics, ossification and identification of bones for determination of age, sex, race, stature etc. forensic anthropometry/osteometry and tools involved.
- Determination of personal identity - sex differences in skull, pelvis and other bones. Calculation of stature from long bones, identification of burnt bones. Recovery and identification of skeletal remains in accidents, crimes and mass disasters.
- Recovery, packing and storage of fleshed and burnt bone remains of human/ animal of forensic importance.
- Facial reconstruction and superimposition techniques, Craniofacial superimposition techniques as photographic and video superimposition.

UNIT-VI

TOOLS AND TECHNIQUES IN BIOLOGY:

- Microscopy: Principles and working of Compound, Comparison, Phase-contrast, stereo-zoom, Polarizing, Fluorescence, confocal microscopy, Scanning electron and transmission electron microscope
- Spectroscopy: Colorimeter analysis and UV light source Principle and significance of UV-Vis spectroscopy, Fluorescence spectroscopy, FRET, Luminescence, Circular Dichroism, Infra-Red spectroscopy, Raman

spectroscopy, Nuclear Magnetic Resonance, X-ray diffraction, Mass spectrometry

- Tissue preparation (1) Fixation and preparation of FFPE blocks (2) Sectioning by rotary microtome, cryostat, vibratome and ultrathin sectioning. (3) Staining: Various staining techniques- simple and double staining, histochemical staining for bio molecules, decalcification of bones and tooth, immunocytochemical staining.
- Electrophoresis: Principle, Agarose and Polyacrylamide gels, Capillary electrophoresis, buffers, staining of the gel
- Statistical analysis - Sample collection and processing, regression and correlation, ANOVA, probability, t-test, importance of p-value, Chi square test.
- Immunological techniques: Immuno-electrophoresis, immune-precipitation, agglutination, RIA, ELISA, FACS, immune-fluorescence microscopy, Immuno-electron microscopy, Fluorescence In-situ hybridization (FISH), Chromatin immuno-precipitation.

UNIT-VII

CRIME SCENE MANAGEMENT & ACTS:

- Introduction to the crime scene and their types.
- Securing and documenting the crime scene (Note making, Sketching, Photography, videography of crime scene)
- Crime Scene Processing: Evaluation of crime scene, role of the first arriving officer at the crime scene, Searching techniques of Crime scene
- Processing of physical evidence: discovering, recognizing and examination of physical evidence, Collection, Safety measures for evidence collection
- Introduction to physical evidence, Types of physical evidence, classification and Role of physical evidence in Criminal Investigations & Trails
- Preservation, packaging, sealing, labelling and forwarding of physical evidence, maintaining the chain of custody
- Reconstruction of crime scene.
- Forensic aspects of The Bharatiya Nyaya (Second) Sanhita, Bharatiya Nagarik Suraksha Sanhita and the Bharatiya Sakshya Act, The Criminal Procedure (Identification) Act

UNIT-VIII

EXAMINATION OF BODY FLUIDS & THEIR STAINS:

- Introduction to Body Fluids and Their Forensic Significance: An overview of various body fluids such as semen, saliva, urine, perspiration, faeces, vomit, and vaginal secretions, along with their role in forensic investigations.
- Identification and Examination of Seminal Stains: composition, occurrence, physical pattern, and forensic significance of seminal stains, along with their identification using presumptive tests (U.V. test, Florence test, Spermine (Barberio) test, Choline test, Acid Phosphatase test) and confirmatory tests (p-30, Prostate-Specific Antigen (PSA), Microscopic examination), Morphological and Biochemical Examination of Spermatozoa.
- Examination of Other Physiological Fluids: Forensic identification and examination of saliva, urine, perspiration, faeces, vomit, and vaginal secretions using appropriate presumptive and confirmatory tests, Identification of Lochial and Menstrual Blood Stains, Importance of Secretor and Non-Secretor Status
- Immunology and related techniques: Innate and Adaptive immunity, B cell / T cell –structure, development, diversity and recognition. Antigen and Antibodies –structure, types and function of antibody, monoclonal antibodies, antigen, hapten, adjuvants, antigen-antibody interaction and their application. Blood groups- ABO, MN, Rh polymorphic blood groups, Presumptive & Confirmatory Tests for blood and its origin: precipitin test (diffusion method)., Application of ABO blood group in disputed paternity cases, polymorphic enzymes and polymorphic proteins in the reference of forensic serology. HLA antigen. Determination of ABO blood group by absorption inhibition, absorption elution and mixed agglutination method.

UNIT-IX

FORENSIC DNA ANALYSIS AND ITS APPLICATIONS:

- Sources of DNA at Crime scenes, Procedure for collection and preservation of biological samples for DNA analysis,
- History of DNA fingerprinting and DNA polymorphism, Genes and DNA markers in forensic DNA analysis
- DNA extraction and quantification techniques including Real Time PCR
- Polymerase Chain Reaction and its variants used in DNA Forensics.
- Various commercial kits for STR profiling, STR profile analysis and its interpretation, Statistical analysis of DNA profiles: Random Match

Probability and Likelihood Ratio.

- Trace DNA typing and its guidelines, Y-STR and X-STR markers analysis, Mitochondrial DNA analysis and its forensic importance.
- Sanger DNA Sequencing method and principles of Next Generation Sequencing Methods.
- Various national/international guidelines for forensic DNA analysis and Interpretations.

UNIT-X

WILDLIFE FORENSICS and ENTOMOLOGY:

- Definition and advances in wildlife forensics; Threats to the natural resources and wild species inhabiting globally.
- Importance of Wildlife Conservation; Classification of Species as per IUCN Red Data Book; CITES; Wildlife (Protection) Act, 1972 of India and other related acts.
- Different Methods of Poaching; Morphological identification and examination of wildlife parts and products for species identification.
- DNA Barcoding for animal species identification.
- Morphology and anatomy of plants, types of plants yielding drugs of abuse– opium, cannabis, coca, tobacco. Identification of plants of Cannabis sativa (Ganja & bhang), opium (Papaver somniferum), tobacco (Nicotiana tabacum) etc. in criminal cases.
- Introduction, History, Significance, Classification and Biology of insects and other arthropods relevant to PMI estimation.
- Life cycle and forensic applications of insects, Dipterans larval development & succession on carrion and its relationship to PMI, impact of ecological factors on insect's developments, rearing insects & calculating PMI, Forensic Entomo-toxicology- identification of drugs and toxins from the insects and larvae feeding on the body.
- Collection and preservation of entomological evidence at a crime scene.

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BIOLOGY DIVISION (M.Sc. BIO-CHEMISTRY)

UNIT-I

FOUNDATION OF BIOCHEMISTRY:

- Foundation of Biochemistry: Cellular and chemical foundations of life, Water: unique properties, weak interactions in aqueous systems, ionization of water, buffering action in biological system.
- Carbohydrate chemistry: Structure and classification of monosaccharides, disaccharides, and polysaccharides, Glycolytic pathway, TCA cycle, pentose phosphate pathways, and glycogen metabolism.
- Lipid Chemistry: Building blocks of lipids - fatty acids, glycerol, ceramide; Structural lipids in membranes – glycerophospholipids; sphingolipids and sterols, Composition and synthesis of lipoproteins and transportation, oxidation of fatty acids, biosynthesis of lipids, cholesterol metabolism.
- Protein Chemistry: Structure and classification of amino acids, peptide, polypeptide, Ramachandran plot, protein folding, Primary, Secondary, Tertiary and Quaternary structure of proteins; essential
- Nucleic acid chemistry: Structure of purine, pyrimidine, nucleoside & nucleotides, Synthesis pathways of purine and pyrimidine, nucleosides, nucleotides and deoxynucleotides, Structure and function of DNA and various types of RNA.

UNIT-II

ENZYMOLOGY:

- Enzyme chemistry: Enzyme definition, basic principle of enzyme action, activation energy, General characteristics of enzymes; nature of enzymes - protein and non-protein (ribozymes – RNaseP, abzymes), apoenzyme, holoenzyme. Fischer's lock and key hypothesis, nomenclature and classification of enzymes, mechanisms of various enzymes including chymotrypsin and lysozyme.
- Enzyme kinetics: Kinetics of single substrate reaction, Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. Determination of KM and Vmax, Kcat, specificity constant. Enzyme Inhibition: Reversible and irreversible inhibition, kinetics of bi-substrate reaction.
- Enzyme regulation: Allosteric enzymes, symmetrical and sequential model, Hill's coefficients, cooperativity, Enzyme regulation and feedback control, enzyme activity regulation by post translational modification.

UNIT-III

GENTICS AND CELL BIOLOGY

- Classical genetics: Mendelian and non-Mendelian inheritance, genetic linkage, recombination and crossing over, chromosomal basis of inheritance, mutagenesis, genetic basis of sex determination, extra-nuclear inheritance.
- Molecular Genetics: Structure of chromatin and chromosomes, Central dogma of molecular biology, replication, transcription, translation, regulation of gene expression: transcriptional, translational and post-translational and various DNA repair mechanisms.
- Cell Biology: Membrane models, chemical composition of membrane, membrane proteins, endocytosis, phagocytosis, liposomes and its application. Cell cycle and cell division (meiosis and mitosis), Structure and functions of intracellular organelles such as nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, plastids, and peroxisomes.

UNIT-IV

DEVELOPMENTAL BIOLOGY

- Basic concept of development: Basic features of development in animals, gametogenesis, types of eggs, fertilization, cleavage, and blastula, modification of development in evolution, generation of multicellular embryo, formation of germ layers, patterning of vertebrate body plan.
- Reproductive Biology: Reproductive strategies and reproductive cycles in vertebrates, spermatogenesis, oogenesis, hormonal regulation in gametogenesis in male and female, In-vitro fertilization, embryo transfer technology.
- Nervous System: Organization of nervous system, somatic nervous system; sympathetic and parasympathetic system; structure and function of neuron and glial cells.
- Musculo-skeletal System: Bone structure and function; smooth, cardiac and skeleton muscles, muscle contraction.
- Endocrinology: Endocrine glands including pituitary, thyroid etc.; hormones, regulation of hormone secretion, peptide hormones and steroid hormones, biochemistry of hormone action.

UNIT-V

BLOOD AND ITS COMPOSITION

- Blood: Components & functions of blood, lymph, CSF; Plasma and serum, major plasma proteins, Erythrocytes, Leukocytes, Platelets- structure and function; role of platelets in coagulation, Biochemical mechanism of blood clotting and fibrinolytic system.
- Glycogen storage diseases: Von Gierke, Pompe, Cori and McArdle.

- Anemia and amino acid metabolism: Hemophilia and thrombosis, Hemoglobin, sickle cell anemia, thalasemia, phenylketonuria, alkaptonuria, albinism, etc.
- Electrolyte and acid balance: Acid-base balance, regulation of electrolyte and water balance, renin-angiotensin system in human body.
- Clinical analysis: Functional test of liver, kidney, thyroid, pancreas, tissue biopsy, liquid biopsy, circulating nucleotides as molecular diagnosis.

UNIT-VI

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development & succession on carrion and its relationship to PMI, impact of ecological factors on insect's developments, rearing insects & calculating PMI, Forensic Entomo-toxicology- identification of drugs and toxins from the insects and larvae feeding on the body.

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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks: 150
3. Number of Questions: 150
4. Duration of Paper: 2.30 Hours
5. All Questions carry equal marks
6. There will be Negative Marking
7. The candidate needs to choose either Zoology or Biochemistry

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER CYBER FORENSIC DIVISION STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

1. Computer Fundamentals

Computer Organization and Architecture (COA): Definition, history, types of computers, block-diagram, processor and its types; I/O devices: input devices, output devices, storage media and its types; Operating System: definition, architecture types of OS, scheduling algorithms, boot process, Master Boot Record (MBR), Volume Boot Record (VBR), boot loaders, process management, memory management, kernel, and system level APIs; File Systems: definition, role of file system in electronic devices, structure, types of file systems, File Allocation Table (FAT), New Technology File System (NTFS), Extended File System (EXT), Apple File System (APFS), Yet Another Flash File System (YAFFS) and other File systems.

2. Networking concepts

Definition; types: Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), Campus Area Network (CAN) and others; Architecture: client-server, peer-to-peer and others; Topology: Bus, Star, Ring, Mesh and others; Network Interface Controller (NIC); Types of media: Co-axial, Twisted Pair, Fiber Optic and others; Open Systems Interconnection (OSI) Reference Model and its layers; TCP/IP Protocol Suite; wired v/s wireless networks; Communication devices: switch, router, gateway and others; Internet: definition, history, Internet Service Provider (ISP), Domain Names, Secure transmission, Proxy, Virtual Private Network (VPN); mailing protocols and file transfer protocols.

3. Database Management Systems (DBMS)

Definition of data; data v/s information; structured v/s unstructured data; definition of DBMS and Relational DBMS (RDBMS); records; tuples; fields; tables; procedures; schemas; types of DBMS/RDBMS; Exiting tools and packages: Oracle MySql, PostgreSQL, SQL Server and others; Structured Query Language (SQL) and NoSQL: Data Definition and Data Manipulation Languages (DDL and DML); Basics SQL Commands; Procedures; Remote Procedure Calls (RPC); No SQL packages; indexing; sorting and searching; Database Administration (DBA): DBMS/RDBMS configurations; backup & restore; logging; recovering corrupted/crashed tables or databases; user rights management; security measures for effective data handling and storage.

4. Software Engineering and Programming Concepts

Software engineering: process; types of software development models; stages of software development and engineering; Types of applications: desktop, mobile, web and others; Software Licenses; Fundamentals of Programming Languages: Procedure Oriented V/S Object Oriented Programming, software testing, packaging, reverse engineering and re-engineering, debugging, deployment, maintenance, secure source code techniques, patch management.

5. Emerging Technologies

AI/ML/DL: Definition of Artificial Intelligence, Machine Learning and Deep Learning, history of AI, types of machine learning, various algorithms of ML/DL, Artificial Neural Network (ANN), Deep Neural Network (DNN), Convolutional Neural Network (CNN), Generative Adversarial Networks (GANs), Computer Vision, Natural Language Processing, Large Language Models (LLMs) and risks related to AI; Internet of Things (IoT): definition, IoT ecosystem, applications of IoT, architecture/layers of IoT, components of IoT, networking protocols in IoT, security concerns and challenges; Blockchain: definition, blockchain concept and decentralized approach, types of blockchain implementation, regulatory challenges and security concerns in blockchain implementation, cryptocurrencies and wallets: AR/VR and Metaverse: Augmented Reality (AR), Virtual Reality (VR), Mixed Reality(MR), Metaverse implementation, challenges and regulatory concerns related to metaverse.

6. Information Security

Information Security: Confidentiality, Integrity and Availability (CIA) Triad, Authentication, Authorization, Non-repudiation; Cryptography & Steganography: Cryptography, Symmetric and Asymmetric algorithms, Hashing Algorithms, Cryptanalysis, Digital Signature, Digital Certificate, Certifying Authorities (CAs), definition of steganography, types and algorithms of steganography, steganalysis and its challenges; Vulnerability Assessment and Penetration Testing (VAPT): definition, vulnerability v/s weakness, types of vulnerabilities, Common Vulnerabilities and Exposures (CVEs), Common Vulnerability Scoring System (CVSS), vulnerability assessment tools and techniques, penetration testing and its methods/tools.

7. Cyber Crimes and Cyber Forensics

Cyber Crimes: definition of cyber/computer crime, types of cyber crimes, known cybercrimes, emerging cyber crimes; Cyber Forensics: definition, branches of cyber forensics, cyber forensic process, definition of electronic evidence, types of electronic evidences, principle of exchange (Locard's exchange principle), search & seizure of electronic evidences, evidence preservation, evidence integrity (chain-of-custody, hashing, etc.), standard operating procedures (SOPs) and best practices in electronic evidence handling and cyber forensics; Malware: definition, types of malware, malware analysis techniques, sandboxing, honeypot, malware samples and challenges involved in malware analysis.

8. Computer Forensics

Disk Forensics: storage media, secondary storage devices, disk, volume, partition, slack space, carving, data recovery and file system restoration; Windows Forensics: Windows boot process, Windows file systems, Windows registry, event logs, prefetch files, shortcut/link files, Most Recently Used (MRU), Shell bags, page file, user accounts and authorization, Windows servers, web history and other important artefacts; Linux Forensics: Linux boot process Linux file systems, logging mechanism in Linux, user accounts and authorization, types of shells, Linux servers (including web servers), web history and other important artefacts; Virtual Machine Forensics: Virtualization, analyzing Virtual Machines (VMs), Windows Subsystem for Linux (WSL) and its investigation.

9. Mobile Forensics

Basics: Mobile and small computing devices, Mobile communications, resource constraints and challenges, types of acquisitions, rooting & jail-breaking; Android: Android OS architecture, android file system, app permissions, logging mechanism in android phone, types of artefacts, tools and technologies for android forensics, challenges & limitations of android forensics; iOS: iPhone OS (iOS) architecture, iOS file system, iOS app permissions, logging in iOS, tools & technologies for iOS forensics, challenges & limitations of iOS forensics; Miscellaneous: Forensic analysis of Pagers, Wearable devices and other smart gadgets, CDR (Call Detail Record) Analysis, handling hoax calls, voice over IP (VoIP) technology and calls.

10. Network Forensics

Crimes committed within or targeting computer networks; challenges involved in acquiring evidences from a computer network; analyzing logs from network devices; Internet Protocol Detail Record (IPDR) analysis; Network Packet Analysis; analysis of server logs; role of Security Information and Event Management (SIEM) and firewall in network forensics; Wireless communications: Wi-Fi, Bluetooth, Near Field Communication (NFC) and other methods of wireless communications; Cloud Forensics: definition of cloud, architecture and types of clouds, containers, dockers, virtualization, analyzing and investigating cloud logs.

11. Multimedia Forensics

Types of multimedia files; types of images; image structure and digital representation; image enhancement techniques; CCTV and DVR basics; analysis of CCTV footage; video files; image/video authentication techniques; differentiating real v/s deepfake audio/image/video; morphing techniques and detection; types of audio files; audio quality enhancement and speaker identification techniques; tools and technologies used for multimedia forensics; AI based CCTV and video analytics techniques.

12. Memory forensics

Live v/s dead forensics; Memory Management; memory structure; importance of RAM Forensics; virtual memory; segmentation; pages and demand paging; page fault; memory address translation; shared memory; types of memory access; processes and threads;

challenges involved in memory acquisition; tools and technologies to acquire and analyze memory dump; important artefacts which could be recovered from Windows/Linux/Android RAM; analyzing malware using memory forensics; event and timeline reconstruction; analyzing memory dumps, page file and hiberfil files.

13. Social Media Investigation and Open Source Intelligence (OSINT)

Information: Definition, type and sources; Investigating social media Platforms: X, Facebook, LinkedIn, Instagram, WhatsApp and others; challenges and limitations of social media platform investigation; tools and technologies available for social media investigation; Open Source Intelligence (OSINT): OSINT and its branches, resources available for OSINT, importance of OSINT in cyber crime investigation, tools and technologies available for OSINT.

14. Emerging trends and challenges in cyber forensics

Dark web: basics of dark web, accessing dark web using The Onion Router (TOR) and working of TOR, TOR nodes, relays and networking, analyzing TOR traffic and websites, limitations and challenges of TOR investigations; AI- Based Crimes: basic of AI-based crimes, deep fake, differentiating between AI-based and traditional crimes, challenges and limitations of investigating AI-based crimes; Drones: basic of Unmanned Aerial Vehicle (UAV), types of UAV, UAV communication protocols, investigating drones and other UAVs, challenges in UAV / Drones investigation.

15. Acts & Legal Frame work

The Information Technology Act, 2000 of India and its amendments; cyber space jurisdiction; important sections of the Bharatiya Nyaya Sanhita (BNS), the Bharatiya Nagarik Suraksha Sanhita (BNSS) and The Bharatiya Sakshya Adhiniyam(BSA) related to cybercrimes; Intellectual Property Rights (IPR) its infringement and legal provisions; Audit and Compliance of Computer and IT infrastructure.

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Pattern of Question Papers:

1. Objective Type Paper
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6. There will be Negative Marking

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SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER DNA DIVISION STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

UNIT – I BIOCHEMISTRY

- Introduction to Biochemistry and Biomolecules – Overview of biochemistry, its scope in biological sciences,
- Water, pH and Buffer system
- Structure and functions of carbohydrates, lipids, proteins, and their structural and functional significance.
- Enzymes– Classification, structure, and function of enzymes, enzyme kinetics, mechanisms of enzyme action, regulation of enzyme activity, and an introduction to major metabolic pathways such as glycolysis, TCA cycle, oxidative phosphorylation, lipid metabolism, and amino acid metabolism.
- Bioenergetics and Metabolic Regulation – Principles of bioenergetics, ATP generation, electron transport chain, oxidative phosphorylation, metabolic control and integration, and the role of hormones in metabolism.

UNIT – II CELL AND MOLECULAR BIOLOGY

- Introduction to Molecular and Cell Biology – Overview of molecular and cell biology, its significance in understanding cellular functions, and its applications in research and medicine.
- Structure and Function of Biomolecules – Detailed study of nucleic acids (DNA & RNA), proteins, lipids, and carbohydrates, emphasizing their roles in cellular processes and molecular interactions.
- Cell Structure and Organelles – Organization of prokaryotic and eukaryotic cells, structure and function of cellular organelles such as the nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, and cytoskeleton.
- DNA Replication, Repair, and Recombination – Mechanisms of DNA replication in prokaryotes and eukaryotes, types of DNA damage, DNA repair pathways, and homologous and site-specific recombination.
- Gene Expression and Regulation – Transcription and translation processes, regulatory elements controlling gene expression, epigenetic modifications, and RNA processing mechanisms.
- Cell Signaling and Communication – Types of cells signaling (autocrine, paracrine, endocrine), signal transduction pathways, role of receptors, second messengers, and cellular responses to external signals.
- Cell Cycle, Growth, and Apoptosis – Phases of the cell cycle, regulatory checkpoints, cyclins and CDKs, mechanisms of cell division (mitosis and

meiosis), and programmed cell death (apoptosis) in maintaining cellular homeostasis.

UNIT – III GENETICS AND BIOINFORMATICS

- Introduction to Genetics and Mendelian Principles – Overview of classical genetics, Mendelian inheritance, laws of segregation and independent assortment, and extensions of Mendelian genetics.
- Chromosomal Basis of Inheritance – Structure and organization of chromosomes, karyotyping, chromosomal aberrations, linkage, recombination, and sex-linked inheritance, types of mutations,
- Population Genetics and Evolutionary Biology – Hardy-Weinberg principle, genetic variation, natural selection, genetic drift, gene flow, speciation, and molecular evolution.
- Variations at Genome Level: Types of polymorphism, various types of genetic markers (VNTR, STR, SNP, CNV) and their detection techniques (RFLP, AFLP, RAPD)
- Introduction to Bioinformatics – Overview of bioinformatics, its applications in biological sciences, databases, and computational tools used in genomics and proteomics.
- Biological Databases and Sequence Alignment – Types of biological databases (NCBI, EMBL, UniProt), sequence retrieval, pairwise and multiple sequence alignment, BLAST, and FASTA.

UNIT – IV MICROBIOLOGY

- Overview of microbiology, history, scope, and classification of microorganisms including bacteria, viruses, fungi, protozoa, and archaea.
- Microbial Structure and Function – Morphology, ultrastructure, and physiology of prokaryotic and eukaryotic microbes, including bacterial cell wall, flagella, pili, spores, and modes of nutrition.
- Sterilization techniques - Physical agents: Dry heat, wet heat and cold sterilization, filtration, radiation; Chemical agents (Disinfectants, antibiotics, alcohols) and their mechanisms.
- Microbial Growth and Metabolism – Growth phases, factors affecting microbial growth, culture media and techniques, bacterial metabolism, and microbial enzymatic activities.
- Different methods for isolation and enumeration of microorganisms from forensic samples like vomit, stool, stomach wash and residual food.
- Microbial Pathogenesis and Host Interaction – Mechanisms of microbial infection, virulence factors, host-pathogen interactions, immune response to infections, and emerging microbial diseases.
- Introduction to bioterrorism, general properties of various biological agents and their mechanisms, Popular case studies of bioterrorism

UNIT – V RECOMBINANT DNA TECHNOLOGY

- Introduction to Recombinant DNA Technology – Overview of genetic engineering, historical developments, scope, and applications in medicine, agriculture, and industry.

- Tools and Techniques in rDNA Technology – Restriction enzymes, DNA ligases, polymerases, vectors (plasmids, phages, cosmids, BACs, YACs), gene cloning, and transformation techniques.
- Gene Cloning and Expression – Cloning strategies, selection and screening of recombinant clones, expression vectors, and factors influencing gene expression in prokaryotic and eukaryotic systems.
- Nucleic Acid Hybridization – Southern, Northern, and Western blotting methods.
- Genome Editing and Genetic Engineering – CRISPR-Cas9, TALENs, ZFNs, gene therapy, transgenic organisms, and ethical considerations in genetic modification.

UNIT – VI IMMUNOLOGY

- Introduction to Immunology and the Immune System – Overview of the immune system, innate and adaptive immunity, components of the immune response, and historical developments in immunology.
- Cells and Organs of the Immune System – Structure and function of immune cells (T-cells, B-cells, macrophages, dendritic cells, NK cells) and primary and secondary lymphoid organs (bone marrow, thymus, spleen, lymph nodes).
- Antigens, Antibodies, and Immune Recognition – Antigen structure and properties, types of antibodies (immunoglobulins), antigen-antibody interactions, and major histocompatibility complex (MHC).
- Immune Response and Regulation – Humoral and cell-mediated immune responses, activation of B and T lymphocytes, cytokines, hypersensitivity reactions, and immunological memory.

UNIT – VII INSTRUMENTAL/ANALYTICAL TECHNIQUES

- Microscopy: Principles and working of Compound, Comparison, Phase-contrast, stereo-zoom, Polarizing, Fluorescence, confocal microscopy, Scanning electron and transmission electron microscope
- Spectroscopy: Colorimeter analysis and UV light source Principle and significance of UV-Vis spectroscopy, Fluorescence spectroscopy, FRET, Luminescence, Circular Dichroism, Infra-Red spectroscopy, Raman spectroscopy, Nuclear Magnetic Resonance, X-ray diffraction, Mass spectrometry
- Electrophoresis: Principle, Agarose and Polyacrylamide gels, Capillary electrophoresis, buffers, staining of the gel
- Centrifugation: Basics of sedimentation, Basics of centrifugation, refrigerated centrifuge, ultra-centrifuge, RPM and RCF properties, Chromatographic

techniques, Basics of chromatography, Types of Chromatography (Size exclusion, Ion-Exchange, Affinity and Paper chromatography)

- Statistical analysis - Sample collection and processing, regression and correlation, ANOVA, probability, t-test, importance of p-value, Chi square test.

UNIT – VIII CRIME SCENE MANAGEMENT & ACTS

- Introduction to the crime scene and their types.
- Securing and documenting the crime scene (Note making, Sketching, Photography, videography of crime scene)
- Crime Scene Processing: Evaluation of crime scene, role of the first arriving officer at the crime scene, Searching techniques of Crime scene
- Processing of physical evidence: discovering, recognizing and examination of physical evidence, Collection, Safety measures for evidence collection
- Introduction to physical evidence, Types of physical evidence, classification and Role of physical evidence in Criminal Investigations & Trails
- Preservation, packaging, sealing, labelling and forwarding of physical evidence, maintaining the chain of custody
- Reconstruction of crime scene.
- Forensic aspects of The Bharatiya Nyaya (Second) Sanhita, Bharatiya Nagarik Suraksha Sanhita and the Bharatiya Sakshya Act, The Criminal Procedure (Identification) Act.

UNIT-IX FORENSIC DNA ANALYSIS AND ITS APPLICATIONS:

- Sources of DNA at Crime scenes, Procedure for collection and preservation of biological samples for DNA analysis,
- History of DNA fingerprinting and DNA polymorphism, Genes and DNA markers in forensic DNA analysis
- DNA extraction and quantification techniques including Real Time PCR
- PCR and its variants
- Various commercial kits for STR profiling, STR profile analysis and its interpretation, Statistical analysis of DNA profiles: Random Match Probability and Likelihood Ratio,
- Low Copy number (LCN) DNA typing and its guidelines, Y-STR and X-STR markers analysis, Mitochondrial DNA analysis and its forensic importance,
- Sanger DNA Sequencing method and principles of Next Generation Sequencing Methods
- Various national/international guidelines for forensic DNA analysis and Interpretations.

UNIT-X WILDLIFE FORENSICS and ENTOMOLOGY:

- Definition and advances in wildlife forensics; Threats to the natural resources and wild species inhabiting globally.
- Importance of Wildlife Conservation; Classification of Species as per IUCN Red Data Book; CITES; Wildlife (Protection) Act, 1972 of India and other related acts.

- Different Methods of Poaching; Conventional methods of species identification; Morphological identification and examination of wildlife parts and products.
- DNA Barcoding for animal species identification.
- Morphology and anatomy of plants, types of plants yielding drugs of abuse– opium, cannabis, coca, tobacco. Identification of plants of Cannabis sativa (Ganja & bhang), opium (Papaver somniferum), tobacco (Nicotiana tabacum) etc. in criminal cases.
- Introduction, History, Significance, Classification and Biology of insects and other arthropods,
- Life cycle and forensic applications of insects, Dipterans larval development & succession on carrion and its relationship to determine time since death, impact of ecological factors on insect's developments, rearing insects & calculating PMI, Forensic Entomo-toxicology- identification of drugs and toxins from the insects and larvae feeding on the body,
- collection and preservation of entomological evidence at a crime scene.

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Pattern of Question Papers:

1. Objective Type Paper
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3. Number of Questions: 150
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6. There will be Negative Marking

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER DOCUMENT DIVISION (M.Sc. PHYSICS) STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

Unit-I

Newton's law of Motion, Frame of reference, inertial and non-inertial frames, Rotating frame of reference, Coriolis force Conservation Laws. Collisions, impact parameter, centre of mass frame, rotational motion of rigid bodies, moment of inertia, products of inertia, conservation of angular momentum. Gravitation & Central forces of motion. Special Theory of Relativity, Michelson-Morely experiment, Lorentz Transformations-addition of velocities, Time dilation and length contraction, variation of mass with velocity, mass-energy equivalence. Kepler's laws, Basic idea of Global Positioning System (GPS).

Unit-II

Oscillations, simple harmonic motion, damped harmonic motion, forced oscillation and resonance. Wave equation, harmonic solutions, plane and spherical waves, superposition of waves, beats, stationary waves Doppler's Effect, phase and group velocities. Conditions of interference, Newton's rings and Michelson's interferometer. Diffraction-Fresnel and Fraunhofer, diffraction by plain transmission grating, Rayleigh criterion, resolving power of grating and telescope.

Unit-III

Electric field and potential, Gauss's law. Poisson's and Laplace equations, dielectrics and polarization, Electromagnetic induction, transformer. Transient behaviour of R-C, and R-L, circuits, time constant. Dielectric property of matter.

Maxwell's equations and their application to plane electromagnetic wave. Polarization, Dipole moment. Vector and scalar potentials; Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics; Fresnel's relations; Total internal reflection; Normal and anomalous dispersion; Lasers, He-Ne and Ruby lasers, spatial and temporal coherence.

Unit-IV

De Borglie waves. Photo-electric effect, Compton effect, wave-particle duality, Uncertainty principle and its applications (like - size of H-atom, zero point energy, wave packet, finite width of energy levels). Schrodinger wave equation with applications for free particle potential step or particle in a one dimensional box, extension of results to three dimensional case, Hydrogen spectrum, electron spin, Stern-Gerlach experiment, Zeeman effect space-quantization, characteristic and continuous x-rays, Bohr Magneton.

Unit-V

Band theory of solids - conductors, insulators and semiconductors; Bloch Theorem, effective mass, Electric conduction in metals, Sommerfeld theory of electrical conductivity, specific heat of solids - Einstein and Debyetheories. Electronic specific heat, Widemann Franz law, Hall effect. Magnetic properties of materials: para,diaferro, anti-ferro and ferrimagnetism. Elements of superconductivity, Meissner effect, Elementary ideas about high temperature superconductivity.

Unit-VI

Kirchhoff's law, Faraday’s law, Lenz’s law, Thevenin, Norton and maximum power-transfer theorems. p-n junction diode, ideal diode equation, use of diode for rectification, zener diode and its use in voltage regulation. Transistor, its biasing, common emitter amplifier. Digital electronics-Boolean identities, De Morgan's laws, logic gates and truth tables; Simple logic circuits. Ballistics Galvanometer-current & charge sensitivity.

Unit-VII

Forensic Document Examination:- Legal aspects of forensic document examination, Classification of documents; Disputed/ Specimen/ Admitted ; Care, handling, preservation of documents; Preliminary examination of case documents, Procurement of samples, Contemporaneous writing. Principle of handwriting examination; Importance of natural variations, Holographic documents. Physiology of handwriting, various writing features– terminology and definitions, class characteristics of handwriting, individual characteristics of handwriting. Nature and types of forgeries, characteristics of genuine and forged signatures, their detection, identification of line quality, artificial and natural tremor. Natural variations in hand writing, Disguised & normal writings.

Unit-VIII

Classification of Erasures: - Chemical & Physical erasures and techniques involved for their detection and decipherment, Sequence of strokes, working principle & features and applications of Video Spectral Comparators, principle and working of Electrostatic Detection apparatus and its applications. Ink examination, chemical composition of different types of inks, destructive and non-destructive techniques involved in differentiation of ink. Secret writings & their decipherment. Writing instruments, working of fountain pen, ball pen, gel pen, writing inks, Printing inks and printing toners. Viscosity, Surface tension, Capillary rise.

Unit-IX

Paper examination: - Physical comparison parameters, chemical composition, sizing & loading materials, tensile strength, comparison techniques: destructive & non-destructive. Examination of seal impressions. Facsimile document/ signature examination. Photocopy and scanned documents: process of scanning, identifying features. Charred documents: preservation and examination techniques involved.

Unit-X

Printed document examination, type-script, classification of printers: identification of printed matter. Examination of computer printouts, Concept of digital signature. Examination of security documents: Currency notes, Passport, Visa, Various identity cards, Stamp papers, travel documents. OVI ink, thermal ink, Examination of credit, debit and other plastic cards.

Unit-XI

Forensic Photography of Documents: Close-up, UV, IR, oblique, side and transmitted light photography. Portable document detector. Working principle of Raman spectrophotometer, TLC, HPTLC, Docucenter Nirvis, Cedar fox and their application, principle & working of the simple microscope, stereo-zoom microscope, comparison microscope.

Unit-XII

Computer Organization and Architecture (COA): Definition, history, types of computers, block-diagram, processor and its types; I/O devices: input devices, output devices, storage media and its types; Operating System, File Systems: definition, File Allocation Table (FAT), MS Word, MS Excel and Power Point Presentation, Basic Knowledge of Internet, Cyber security, Artificial Intelligence

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DOCUMENT DIVISION (M.Sc. CHEMISTRY)

Unit I

Bohr's Theory, Atomic Stricture, Wave Mechanics, de Broglie's equations, Heisenberg's uncertainty Principle, Quantum Numbers, Pauli's exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle.

Analytical Chemistry: Classification of analytical methods – Classical and Instrumental, volumetric, titrimetric and gravimetric techniques, selection of proper analytical techniques: types and range of determination, accuracy, precision and errors, sample preparation, handling of reagents with safety, density and viscosity measurements.

Unit II

Periodicity of elements s, p, d, f block elements and their nature & anomaly, ionic bond, covalent bond, H-bonds, Vander wall forces, Entropy, Enthalpy, electro negativity, Born- Haber cycle, Valence Bond Theory, Hybridization & Resonance. Noble Gases.

Analysis of unknown samples: -
Organic: Physical examination, element detection (N, S, Cl, Br, I, F), Functional Group analysis (-OH, -COOH, $-NO_2$, $-NH_2$, $-CONH_2$, -CO-, -CHO, Hydrocarbons)
Inorganic: Qualitative analysis of cations and anions with special reference to cations i.e. As, Sb, Pb, Ba, Cu, Hg, Zn and Tl and anions i.e.NO_2^-, NO_3^-, S^{2-}, SO_4^{2-}, SO_3^{2-}, halides and cyanides.
Analysis of poisonous gases: CO, H_2S, PH_3, CH_4 and NH_3.

Unit III

Spectroscopic and other techniques: -
Unifying principles: Electromagnetic radiation, interaction of electromagnetic radiation with matter- absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering.
Basic principles, instrumentation and applications: UV- Visible, FTIR, AAS, Mass, Spectroscopy, Fluorescence and Phosphorescence spectrophotometry, ESR Spectroscopy, ED-XRF.
Fundamentals of Acids, Bases and Buffers, pH, pK_a, and pK_b values, principles, instrumentation and applications of pH metry, Potentiometry, Conductometry and colorimetry. Microscopic analysis in forensic Science.

Unit IV

Chromatography and Electrophoresis: -General Principles and types of chromatographic techniques: Paper chromatography, column chromatography, Thin layer chromatography, adsorption chromatography, partition chromatography, Gas chromatography, Gas-liquid chromatography, Ion exchange chromatography,

Exclusion (permeation) chromatography, affinity chromatography, HPLC, HPTLC, Capillary Chromatography, GC-MS and Electrophoresis.

Unit V

Chemical Thermodynamics, Laws of Thermodynamics, Thermochemistry, Electrochemistry, Gibbs & Helmholtz energy, free energy, chemical equilibrium, degree of freedom, solution & colligative properties, dilute solutions, Raoult's & Henery's Laws. Coordination chemistry. Werner's theory. IUPAC. Ligand field.

Basic Organic Chemistry: Important preparations and properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, carboxylic acids, aldehydes, ketones, amines and nitro compounds.

Unit VI

Amino acids, Peptides, Proteins: Classification, Structure and Properties, Molecular weight determination, ATPs. Isoelectric point, coagulation and denaturation. Carbohydrates: Classification, Structure and Reactions. Fats and Lipids: Classification, Structure and Reactions.
Alkaloids: Classification, Isolation and Identification.
Terpenes, Bio-inorganic chemistry: - metal-ion present in biological system, Na/K pump, Toxicity of metal-ions. Chelating agents.

Unit-VII

Forensic Document Examination: - Legal aspects of forensic document examination, Classification of documents; Disputed/ Specimen/ Admitted; Care, handling, preservation of documents; Preliminary examination of case documents, Procurement of samples, Contemporaneous writing. Principle of handwriting examination; Importance of natural variations, Holographic documents. Physiology of handwriting, various writing features– terminology and definitions, class characteristics of handwriting, individual characteristics of handwriting. Nature and types of forgeries, characteristics of genuine and forged signatures, their detection, identification of line quality, artificial and natural tremor. Natural variations in hand writing, Disguised & normal writings.

Unit-VIII

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Unit-IX

Paper examination: - Physical comparison parameters, chemical composition, sizing & loading materials, tensile strength, comparison techniques: destructive & non-destructive. Examination of seal impressions. Facsimile document/ signature examination. Photocopy and scanned documents: process of scanning, identifying features. Charred documents: preservation and examination techniques involved.

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Unit-XI

Forensic Photography of Documents: Close-up, UV, IR, oblique, side and transmitted light photography. Portable document detector. Working principle of Raman spectrophotometer, TLC, HPTLC, Docucenter Nirvis, Cedar fox and their application, principle & working of the simple microscope, stereo-zoom microscope, comparison microscope.

Unit-XII

Computer Organization and Architecture (COA): Definition, history, types of computers, block-diagram, processor and its types; I/O devices: input devices, output devices, storage media and its types; Operating System, File Systems: definition, File Allocation Table (FAT), MS Word, MS Excel and Power Point Presentation, Basic Knowledge of Internet, Cyber security, Artificial Intelligence.

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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks: 150
3. Number of Questions: 150
4. Duration of Paper: 2.30 Hours
5. All Questions carry equal marks
6. There will be Negative Marking
7. The candidate has to choose either Physics or Chemistry

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER NARCOTICS DIVISION STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

UNIT I

Analytical Chemistry: Classification of analytical methods – Classical and Instrumental, volumetric, titrimetric and gravimetric techniques, selection of proper analytical techniques: types and range of determination, accuracy, precision and errors, sample preparation, handling of reagents with safety, density and viscosity measurements. Good Laboratory Practices, Standard Operating Procedures, quality assurance and quality control, validation of analytical methods.

Statistical Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test.

UNIT II

Basics of Physical, Inorganic and Organic Chemistry

Properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, carboxylic acids, aldehydes, ketones, amines and nitro compounds.

Proteins: Classification, Structure and Properties, Molecular weight determination, Isoelectric point, coagulation and denaturation.

Carbohydrates: Classification, Structure and Reactions.

Fats and Lipids: Classification, Structure and Reactions.

Alkaloids: Classification, Isolation and Identification.

Sample Preparation Techniques: Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction. Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution. Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE).

UNIT III

General Principles of Biological / Biochemical Analysis: pH and Buffers, Physiological solution Centrifugation Techniques, Basic principle of sedimentation, various types of

centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge- Refrigerated Centrifuges.

Microscopy: Basic principles of microscopy, Simple and Compound microscope, Study of different types of microscopes: Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM)

UNIT IV

Electromagnetic radiations: General properties of electromagnetic radiations, Wave and Quantum mechanical properties, Interaction of EMR with matter, electronic spectra and molecular structure, Internal standards and standard addition calibration methods.

Introduction, Theory, Principle, Instrumentation and Applications of Spectroscopic Techniques: Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, FT-IR, Raman Spectroscopy, FT-Raman spectroscopy, Flame emission spectrometry, Atomic Absorption Spectrometry and Atomic Fluorescence Spectrometry.

UNIT V

Separation Techniques: Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography.

Introduction, Theory, Principle, Instrumentation and Applications of Thin Layer Chromatography, High Performance Thin Layer Chromatography, Gas Chromatography; Gas-liquid and gas-solid chromatography, High Performance Liquid Chromatography, Gas Chromatography – Head Space: Principle, instrumentation and applications.

Emerging and Hyphenate Techniques: Theory, Instrumentation and Applications Mass Spectroscopy, Inductively Coupled Plasma-Mass Spectroscopy, X-Ray Spectroscopy, Gas Chromatography - Mass Spectroscopy (GC– MS) and GC – MS – MS (Tandem), Liquid Chromatography-Mass Spectroscopy (LC – MS) and LC – MS – MS (Tandem), Capillary Chromatography

Introduction, Theory, Principle, Instrumentation and Applications of Electrophoretic techniques.

UNIT VI

Basics of Forensic Science: Definition, history, principle, scope and development of Forensic science, Forensic Science Laboratories in India, Functions and responsibility of Forensic scientist.

Crime: Definition, types of crimes, Modus Operandi, Law as per Bhartiya Sakshya Adhiniyam, Bhartiya Nagrik Suraksha Sanhita, Bhartiya Nyaya Sanhita.

Court testimony: Admissibility of expert testimony, pre court preparation and court appearance, examination in chief, cross examination and re- examination. Ethics in Forensic Science.

UNIT VII

Crime Scene Investigation: Introduction, types of crime scene, Evaluation and processing of crime scene, Securing and Documenting the crime scene (Note making, Sketching, Photography, videography of crime scene), role of the first arriving officer at the crime scene, Digital Imaging of Crime Scene, 3-D scanning technique, Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidences, Collection, Safety measures for evidence collection, Preservation, Packaging, sealing, labelling and forwarding of physical evidences, Maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime.

Introduction to evidences, Types, Classification and Role of evidences in Criminal Investigations & Trails, Tele forensic Technology for crime scene investigation, Mobile kits and equipments, their utility on crime scene, Technology innovation in crime scene management, Report writing, Components of reports and report format in respect of crime scene and laboratory findings.

UNIT VIII

Introduction to drugs, Designer Drugs, Drugs of abuse, mode of administration, pharmacological action, biotransformation, types, appearance, production and chemical characteristics, Common terminology of various drugs of forensic importance.

Introduction to Controlled Substances, Controlled Substance Act, Classification of controlled substances, Precursor chemicals, Narcotic raids and clandestine drug laboratories evidences and forensic examination. Provisions under Drugs Act, Excise Act and NDPS Act.

UNIT IX

Narcotics drugs: Definition, types, appearance, production and chemical characteristics. Common terminology of various drugs. Drug action on central nervous system. Sampling methods, extraction, isolation and analytical techniques for qualitative & quantitative analysis.

Plants of Narcotic importance and their morphology: Papaver somniferum, Cannabis sativa, Coca plant and analysis of their active constituents.

UNIT X

Extraction, isolation & identification of Alkaloids viz- Morphine, Codeine, Brucine, Strychnine, Nicotine, Atropine, Hyoscyamine, Cocaine, Heroin and Dhatura alkaloids.

Psychotropic substances: Chemistry and analysis of Amphetamines, Benzodiazepines and their derivatives. Barbiturates, Lysergides, Mascalines and Psilocybin etc.

Extraction, isolation & identification of sedative, depressants, stimulants, opiates and drugs of abuse.

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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks: 150
3. Number of Questions: 150
4. Duration of Paper: 2.30 Hours
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6. There will be Negative Marking

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER PHYSICS DIVISION STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

Unit-I

Newton's law of Motion, Frame of reference, inertial and non-inertial frames, Rotating frame of reference, Coriolis force Conservation Laws. Collisions, impact parameter, centre of mass frame, rotational motion of rigid bodies, moment of inertia, products of inertia, conservation of angular momentum. Gravitation & Central forces of motion. Special Theory of Relativity, Michelson-Morely experiment, Lorentz Transformations-addition of velocities, Time dilation and length contraction, variation of mass with velocity, mass-energy equivalence. Kepler's laws, Basic idea of Global Positioning System (GPS).

Unit-II

Oscillations, simple harmonic motion, damped harmonic motion, forced oscillation and resonance. Wave equation, harmonic solutions, plane and spherical waves, superposition of waves, beats, stationary waves Doppler's Effect, phase and group velocities. Conditions of interference, Newton's rings and Michelson's interferometer. Diffraction-Fresnel and Fraunhofer, diffraction by plain transmission grating, Rayleigh criterion, resolving power of grating and telescope.

Unit-III

Electric field and potential, Gauss's law. Poisson's and Laplace equations, dielectrics and polarization, Electromagnetic induction, transformer. Transient behaviour of R-C, and R-L, circuits, time constant. Dielectric property of matter.

Maxwell's equations and their application to plane electromagnetic wave. Polarization, Dipole moment. Vector and scalar potentials; Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics; Fresnel's relations; Total internal reflection; Normal and anomalous dispersion; Lasers, He-Ne and Ruby lasers, spatial and temporal coherence.

Unit-IV

De Borglie waves. Photo-electric effect, Compton effect, wave-particle duality, Uncertainty principle and its applications (like - size of H-atom, zero point energy, wave packet, finite width of energy levels). Schrodinger wave equation with applications for free particle potential step or particle in a one dimensional box, extension of results to three dimensional case, Hydrogen spectrum, electron spin, Stern-Gerlach experiment, Zeeman effect space-quantization, characteristic and continuous x-rays, Bohr Magneton.

Unit-V

Band theory of solids - conductors, insulators and semiconductors; Bloch Theorem, effective mass, Electric conduction in metals, Sommerfeld theory of electrical conductivity, specific heat of solids - Einstein and Debyetheories. Electronic specific heat, Widemann Franz law, Hall effect. Magnetic properties of materials: para,diaferro, anti-ferro and ferrimagnetism. Elements of superconductivity, Meissner effect, Elementary ideas about high temperature superconductivity.

Unit-VI

Kirchhoff's law, Faraday's law, Lenz's law, Thevenin, Norton and maximum power-transfer theorems. p-n junction diode, ideal diode equation, use of diode for rectification, zener diode and its use in voltage regulation. Transistor, its biasing, common emitter amplifier. Digital electronics-Boolean identities, De Morgan's laws, logic gates and truth tables; Simple logic circuits. Ballistics Galvanometer-current & charge sensitivity.

UNIT -VII

Forensic Physics: Introduction and scope, tools and techniques, examination of vehicle in case of road traffic accident, skid marks evaluation. Physical Evidences: types and importance. Forensic Statistics: Types of data, measure of central tendency, dispersion of data, correlations and probability and proof.

Glass: Types of glass and their composition-soda-lime, boro-silicate, safety glass, laminated, light-sensitive, tampered/ toughened, wire glass, coloured glass. Matching and comparison. Forensic examinations of glass fractures-concentric and radial fractures. Colour, fluorescence, physical measurements, specific gravity examination and elemental analysis of glass evidence.
Paint: Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test,

pyrolysis gas chromatography, TLC, colorimetric analysis, IR spectroscopy and X-ray diffraction, elemental analysis, mass spectrometer, interpretation of paint evidence.

UNIT -VIII

Fibre: Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy. Miscellaneous Evidences: wire, broken bangles, seals, counterfeit coins, ropes/ strings, synthetic fibers etc their introduction & forensic examination. Tool Marks: theory, types of tool marks, and their forensic examination, Restoration methods of obliterated marks, Impression evidences-seal, stamp, tyre etc, SEM, TEM, ED-XRF, X-Ray diffraction Spectroscopy, Atomic Force microscopy, ICP-AES, ICP-MS, FTIR, MS, AAS.

UNIT-IX

Building Materials: Cement- composition, types, Forensic Analysis- bromoform test, fineness test, ignition-loss test, Identification of adulterated cement. Mortar and concrete analysis. Soil: Types and composition of soil, sample preparation, removal of contaminants, colour, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis. SOP for examination, interpretation of results. Nanoparticle: - utilization and application of nano technology in analysis of physical evidence.

UNIT -X

Audio and Video Analysis and Tape Authentication: theory of voice production, theory of voice identification, acoustics of speech, the sound spectrograph, voice comparison -standards and methods of voice comparison, voice spectrograph and its significance. Speech recognition and speaker identification.

Statistical Analysis : Mean, Mode, Median, Correlation and Regression analysis, Null Hypothesis, Variance, t-test, Chi-Square test. Type of Data, Measure of central tendency, Dispersion of Data, Correlation, Probability and Proof.

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RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER SEROLOGY DIVISION (M.Sc. ZOOLOGY) STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

UNIT-I

CELL STRUCTURE, MOLECULES AND THEIR INTERACTION:

- Structural organization and functions of cell organelles: Plasma membrane, intracellular organelles (Nucleus, Mitochondria, Golgi-bodies, Lysosomes, Endoplasmic reticulum, Peroxysomes) and types and structure of Chromosomes
- pH, buffer and buffer system.
- Bio-molecules-Structure, composition and function (carbohydrates, lipids, proteins and nucleic acids)
- Enzymes- types and their functions, regulation, enzyme inhibition, iso-enzymes.
- Structure and Functions of nucleic acids, Processes of DNA Replication, Transcription and Translation.
- Cell division and cell cycle in eukaryotic organisms.

UNIT-II

HUMAN ANATOMY AND PHYSIOLOGY:

- Tissues of body: epithelia and glands, their classification and functions, connective tissues, cartilage- structure and types,
- Bones- formation, gross structure, fracture and healing, Structure and growth of teeth, types, dentition-pattern and formula, eruption sequence and age determination, dental anomalies and their significance in personal identification, bite marks of human/animals and their analysis.
- Structure and functions of major organ systems and their physiology- Integumentary, digestive, skeleton, respiratory, endocrine, nervous, cardiovascular, excretory, reproductive, muscular and neuromuscular systems, blood physiology.

UNIT-III

ECOLOGY, ENVIRONMENT AND MICROBIOLOGY:

- Ecosystem and their types, ecological factors, types of pollution,
- Types of waste, BOD, COD, effect on human health, algal blooms and identification and composition, eutrophication and their effects.
- Various types of planktons and diatoms. Diatom tests and its importance

in drowning cases, precautions in collection, preservation and forwarding of biological samples for diatom test, methods of isolation of diatoms from different body tissues/bone marrow and water samples.

- Isolation and classification of various microbes from soil, water and food. Cell structure of bacteria and fungi, spores.

UNIT IV

ANIMAL CLASSIFICATION AND BASIC GENETICS:

- Chemotaxonomy, Cytotaxonomy, Molecular Taxonomy and General classification of Animals (classification of Invertebrates up to order, classification of chordates up to class)
- Mendelian and non-mendelian inheritance, linkage, recombination and crossing over, chromosomal basis of inheritance, sex linked inheritance, chromosomal aberration.

UNIT- V

FORENSIC TECHNIQUES: ANTHROPOLOGY

- Anatomical description of skeletons of human and animals as relevant to forensics, ossification and identification of bones for determination of age, sex, race, stature etc. forensic anthropometry/osteometry and tools involved.
- Determination of personal identity - sex differences in skull, pelvis and other bones. Calculation of stature from long bones, identification of burnt bones. Recovery and identification of skeletal remains in accidents, crimes and mass disasters.
- Recovery, packing and storage of fleshed and burnt bone remains of human/ animal of forensic importance.
- Facial reconstruction and superimposition techniques, Craniofacial superimposition techniques as photographic and video superimposition.

UNIT-VI

TOOLS AND TECHNIQUES IN BIOLOGY:

- Microscopy: Principles and working of Compound, Comparison, Phase-contrast, stereo-zoom, Polarizing, Fluorescence, confocal microscopy, Scanning electron and transmission electron microscope
- Spectroscopy: Colorimeter analysis and UV light source Principle and significance of UV-Vis spectroscopy, Fluorescence spectroscopy, FRET, Luminescence, Circular Dichroism, Infra-Red spectroscopy, Raman spectroscopy, Nuclear Magnetic Resonance, X-ray diffraction, Mass spectrometry
- Tissue preparation (1) Fixation and preparation of FFPE blocks (2) Sectioning by rotary microtome, cryostat, vibratome and ultrathin

sectioning. (3) Staining: Various staining techniques- simple and double staining, histochemical staining for bio molecules, decalcification of bones and tooth, immunocytochemical staining.

- Electrophoresis: Principle, Agarose and Polyacrylamide gels, Capillary electrophoresis, buffers, staining of the gel
- Statistical analysis - Sample collection and processing, regression and correlation, ANOVA, probability, t-test, importance of p-value, Chi square test.
- Immunological techniques: Immuno-electrophoresis, immune-precipitation, agglutination, RIA, ELISA, FACS, immune-fluorescence microscopy, Immuno-electron microscopy, Fluorescence In-situ hybridization (FISH), Chromatin immuno-precipitation.

UNIT-VII

CRIME SCENE MANAGEMENT & ACTS:

- Introduction to the crime scene and their types.
- Securing and documenting the crime scene (Note making, Sketching, Photography, videography of crime scene)
- Crime Scene Processing: Evaluation of crime scene, role of the first arriving officer at the crime scene, Searching techniques of Crime scene
- Processing of physical evidence: discovering, recognizing and examination of physical evidence, Collection, Safety measures for evidence collection
- Introduction to physical evidence, Types of physical evidence, classification and Role of physical evidence in Criminal Investigations & Trails
- Preservation, packaging, sealing, labelling and forwarding of physical evidence, maintaining the chain of custody
- Reconstruction of crime scene.
- Forensic aspects of The Bharatiya Nyaya (Second) Sanhita, Bharatiya Nagarik Suraksha Sanhita and the Bharatiya Sakshya Act, The Criminal Procedure (Identification) Act

UNIT-VIII

EXAMINATION OF BODY FLUIDS & THEIR STAINS:

- Introduction to Body Fluids and Their Forensic Significance: An overview of various body fluids such as semen, saliva, urine, perspiration, faeces, vomit, and vaginal secretions, along with their role in forensic investigations.

- Identification and Examination of Seminal Stains: composition, occurrence, physical pattern, and forensic significance of seminal stains, along with their identification using presumptive tests (U.V. test, Florence test, Spermine (Barberio) test, Choline test, Acid Phosphatase test) and confirmatory tests (p-30, Prostate-Specific Antigen (PSA), Microscopic examination), Morphological and Biochemical Examination of Spermatozoa.
- Examination of Other Physiological Fluids: Forensic identification and examination of saliva, urine, perspiration, faeces, vomit, and vaginal secretions using appropriate presumptive and confirmatory tests, Identification of Lochial and Menstrual Blood Stains, Importance of Secretor and Non-Secretor Status
- Immunology and related techniques: Innate and Adaptive immunity, B cell / T cell –structure, development, diversity and recognition. Antigen and Antibodies –structure, types and function of antibody, monoclonal antibodies, antigen, hapten, adjuvants, antigen-antibody interaction and their application. Blood groups- ABO, MN, Rh polymorphic blood groups, Presumptive & Confirmatory Tests for blood and its origin: precipitin test (diffusion method)., Application of ABO blood group in disputed paternity cases, polymorphic enzymes and polymorphic proteins in the reference of forensic serology. HLA antigen. Determination of ABO blood group by absorption inhibition, absorption elution and mixed agglutination method.

UNIT-IX

FORENSIC DNA ANALYSIS AND ITS APPLICATIONS:

- Sources of DNA at Crime scenes, Procedure for collection and preservation of biological samples for DNA analysis,
- History of DNA fingerprinting and DNA polymorphism, Genes and DNA markers in forensic DNA analysis
- DNA extraction and quantification techniques including Real Time PCR
- Polymerase Chain Reaction and its variants used in DNA Forensics.
- Various commercial kits for STR profiling, STR profile analysis and its interpretation, Statistical analysis of DNA profiles: Random Match Probability and Likelihood Ratio.
- Trace DNA typing and its guidelines, Y-STR and X-STR markers analysis, Mitochondrial DNA analysis and its forensic importance.
- Sanger DNA Sequencing method and principles of Next Generation Sequencing Methods.
- Various national/international guidelines for forensic DNA analysis and Interpretations.

UNIT-X

WILDLIFE FORENSICS and ENTOMOLOGY:

- Definition and advances in wildlife forensics; Threats to the natural resources and wild species inhabiting globally.
- Importance of Wildlife Conservation; Classification of Species as per IUCN Red Data Book; CITES; Wildlife (Protection) Act, 1972 of India and other related acts.
- Different Methods of Poaching; Morphological identification and examination of wildlife parts and products for species identification.
- DNA Barcoding for animal species identification.
- Morphology and anatomy of plants, types of plants yielding drugs of abuse– opium, cannabis, coca, tobacco. Identification of plants of Cannabis sativa (Ganja & bhang), opium (Papaver somniferum), tobacco (Nicotiana tabacum) etc. in criminal cases.
- Introduction, History, Significance, Classification and Biology of insects and other arthropods relevant to PMI estimation.
- Life cycle and forensic applications of insects, Dipterans larval development & succession on carrion and its relationship to PMI, impact of ecological factors on insect's developments, rearing insects & calculating PMI, Forensic Entomo-toxicology- identification of drugs and toxins from the insects and larvae feeding on the body.
- Collection and preservation of entomological evidence at a crime scene.

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SEROLOGY DIVISION (M.Sc. BIO-CHEMISTRY)

UNIT-I

FOUNDATION OF BIOCHEMISTRY:

- Foundation of Biochemistry: Cellular and chemical foundations of life, Water: unique properties, weak interactions in aqueous systems, ionization of water, buffering action in biological system.
- Carbohydrate chemistry: Structure and classification of monosaccharides, disaccharides, and polysaccharides, Glycolytic pathway, TCA cycle, pentose phosphate pathways, and glycogen metabolism.
- Lipid Chemistry: Building blocks of lipids - fatty acids, glycerol, ceramide; Structural lipids in membranes – glycerophospholipids; sphingolipids and sterols, Composition and synthesis of lipoproteins and transportation, oxidation of fatty acids, biosynthesis of lipids, cholesterol metabolism.
- Protein Chemistry: Structure and classification of amino acids, peptide, polypeptide, Ramachandran plot, protein folding, Primary, Secondary, Tertiary and Quaternary structure of proteins; essential
- Nucleic acid chemistry: Structure of purine, pyrimidine, nucleoside & nucleotides, Synthesis pathways of purine and pyrimidine, nucleosides, nucleotides and deoxynucleotides, Structure and function of DNA and various types of RNA.

UNIT-II

ENZYMOLOGY:

- Enzyme chemistry: Enzyme definition, basic principle of enzyme action, activation energy, General characteristics of enzymes; nature of enzymes - protein and non-protein (ribozymes – RNaseP, abzymes), apoenzyme, holoenzyme. Fischer's lock and key hypothesis, nomenclature and classification of enzymes, mechanisms of various enzymes including chymotrypsin and lysozyme.
- Enzyme kinetics: Kinetics of single substrate reaction, Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. Determination of KM and Vmax, Kcat, specificity constant. Enzyme Inhibition: Reversible and irreversible inhibition, kinetics of bi-substrate reaction.
- Enzyme regulation: Allosteric enzymes, symmetrical and sequential model, Hill's coefficients, cooperativity, Enzyme regulation and feedback control, enzyme activity regulation by post translational modification.

UNIT-III

GENTICS AND CELL BIOLOGY

- Classical genetics: Mendelian and non-Mendelian inheritance, genetic linkage, recombination and crossing over, chromosomal basis of inheritance,

mutagenesis, genetic basis of sex determination, extra-nuclear inheritance.

- Molecular Genetics: Structure of chromatin and chromosomes, Central dogma of molecular biology, replication, transcription, translation, regulation of gene expression: transcriptional, translational and post-translational and various DNA repair mechanisms.
- Cell Biology: Membrane models, chemical composition of membrane, membrane proteins, endocytosis, phagocytosis, liposomes and its application. Cell cycle and cell division (meiosis and mitosis), Structure and functions of intracellular organelles such as nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, plastids, and peroxisomes.

UNIT-IV

DEVELOPMENTAL BIOLOGY

- Basic concept of development: Basic features of development in animals, gametogenesis, types of eggs, fertilization, cleavage, and blastula, modification of development in evolution, generation of multicellular embryo, formation of germ layers, patterning of vertebrate body plan.
- Reproductive Biology: Reproductive strategies and reproductive cycles in vertebrates, spermatogenesis, oogenesis, hormonal regulation in gametogenesis in male and female, In-vitro fertilization, embryo transfer technology.
- Nervous System: Organization of nervous system, somatic nervous system; sympathetic and parasympathetic system; structure and function of neuron and glial cells.
- Musculo-skeletal System: Bone structure and function; smooth, cardiac and skeleton muscles, muscle contraction.
- Endocrinology: Endocrine glands including pituitary, thyroid etc.; hormones, regulation of hormone secretion, peptide hormones and steroid hormones, biochemistry of hormone action.

UNIT-V

BLOOD AND ITS COMPOSITION

- Blood: Components & functions of blood, lymph, CSF; Plasma and serum, major plasma proteins, Erythrocytes, Leukocytes, Platelets- structure and function; role of platelets in coagulation, Biochemical mechanism of blood clotting and fibrinolytic system.
- Glycogen storage diseases: Von Gierke, Pompe, Cori and McArdle.
- Anemia and amino acid metabolism: Hemophilia and thrombosis, Hemoglobin, sickle cell anemia, thalasemia, phenylketonuria, alkaptonuria, albinism, etc.
- Electrolyte and acid balance: Acid-base balance, regulation of electrolyte and water balance, renin-angiotensin system in human body.
- Clinical analysis: Functional test of liver, kidney, thyroid, pancreas, tissue biopsy, liquid biopsy, circulating nucleotides as molecular diagnosis.

UNIT-VI

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- Microscopy: Principles and working of Compound, Comparison, Phase-contrast, stereo-zoom, Polarizing, Fluorescence, confocal microscopy, Scanning electron and transmission electron microscope
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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks: 150
3. Number of Questions: 150
4. Duration of Paper: 2.30 Hours
5. All Questions carry equal marks
6. There will be Negative Marking
7. The candidate must choose either Zoology or Biochemistry

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC OFFICER TOXICOLOGY DIVISION STATE FORENSIC SCIENCE LABORATORY (HOME DEPARTMENT)

UNIT I

Analytical Chemistry: Classification of analytical methods – Classical and Instrumental, volumetric, titrimetric and gravimetric techniques, selection of proper analytical techniques: types and range of determination, accuracy, precision and errors, sample preparation, handling of reagents with safety, density and viscosity measurements. Good Laboratory Practices, Standard Operating Procedures, quality assurance and quality control, validation of analytical methods.

Statistical Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test.

UNIT II

Basics of Physical, Inorganic and Organic Chemistry

Properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, carboxylic acids, aldehydes, ketones, amines and nitro compounds.

Proteins: Classification, Structure and Properties, Molecular weight determination, Isoelectric point, coagulation and denaturation.

Carbohydrates: Classification, Structure and Reactions.

Fats and Lipids: Classification, Structure and Reactions.

Alkaloids: Classification, Isolation and Identification.

Sample Preparation Techniques: Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction. Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution. Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE).

UNIT III

General Principles of Biological / Biochemical Analysis: pH and Buffers, Physiological solution Centrifugation Techniques, Basic principle of sedimentation, various types of

centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge- Refrigerated Centrifuges.

Microscopy: Basic principles of microscopy, Simple and Compound microscope, Study of different types of microscopes: Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM)

UNIT IV

Electromagnetic radiations: General properties of electromagnetic radiations, Wave and Quantum mechanical properties, Interaction of EMR with matter, electronic spectra and molecular structure, Internal standards and standard addition calibration methods.

Introduction, Theory, Principle, Instrumentation and Applications of Spectroscopic Techniques: Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, FT-IR, Raman Spectroscopy, FT-Raman spectroscopy, Flame emission spectrometry, Atomic Absorption Spectrometry and Atomic Fluorescence Spectrometry.

UNIT V

Separation Techniques: Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography.

Introduction, Theory, Principle, Instrumentation and Applications of Thin Layer Chromatography, High Performance Thin Layer Chromatography, Gas Chromatography; Gas-liquid and gas-solid chromatography, High Performance Liquid Chromatography, Gas Chromatography – Head Space: Principle, instrumentation and applications.

Emerging and Hyphenate Techniques: Theory, Instrumentation and Applications Mass Spectroscopy, Inductively Coupled Plasma-Mass Spectroscopy, X-Ray Spectroscopy, Gas Chromatography - Mass Spectroscopy (GC– MS) and GC – MS – MS (Tandem), Liquid Chromatography-Mass Spectroscopy (LC – MS) and LC – MS – MS (Tandem), Capillary Chromatography

Introduction, Theory, Principle, Instrumentation and Applications of Electrophoretic techniques.

UNIT VI

Basics of Forensic Science: Definition, history, principle, scope and development of Forensic science, Forensic Science Laboratories in India, Functions and responsibility of Forensic scientist.

Crime: Definition, types of crimes, Modus Operandi, Law as per Bhartiya Sakshya Adhiniyam, Bhartiya Nagrik Suraksha Sanhita, Bhartiya Nyaya Sanhita.

Court testimony: Admissibility of expert testimony, pre court preparation and court appearance, examination in chief, cross examination and re- examination. Ethics in Forensic Science.

UNIT VII

Crime Scene Investigation: Introduction, types of crime scene, Evaluation and processing of crime scene, Securing and Documenting the crime scene (Note making, Sketching, Photography, videography of crime scene), role of the first arriving officer at the crime scene, Digital Imaging of Crime Scene, 3-D scanning technique, Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidences, Collection, Safety measures for evidence collection, Preservation, Packaging, sealing, labelling and forwarding of physical evidences, Maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime.

Introduction to evidences, Types, Classification and Role of evidences in Criminal Investigations & Trails, Tele forensic Technology for crime scene investigation, Mobile kits and equipments, their utility on crime scene, Technology innovation in crime scene management, Report writing, Components of reports and report format in respect of crime scene and laboratory findings.

UNIT VIII

Forensic Toxicology: Introduction and concepts of forensic toxicological examination and its significance. Law related to poisons, Introduction to Poisons, form of poisons, classification of Poisons and methods of administration of poison, Mode of action of poison, Diagnosis and management of poisoning cases. Factors affecting the effect of poison, Symptoms of poisoning and antidotes. Types of poisoning cases. Collection and preservation of toxicological exhibits in poisoning cases. Postmortem examination and postmortem changes. Medico-legal aspects in poisoning cases.

Collection and preservation of biological evidences (viscera and /or body fluids) and circumstantial evidences in fatal and survival cases

UNIT IX

Classification of matrices. Isolation and Extraction of poison/ drug by Solvent extraction, distillation/steam distillation, micro diffusion, dialysis, dry ashing and wet digestion.

Method of analysis of Inorganic poisons (metallic, non-metallic and anions). Method of analysis of Neutral poison. Method of analysis of Basic drugs / poisons. Method of analysis of Acidic drugs / poisons. Method of analysis of volatile poisons and noxious gases. Method of analysis of Insects and animal poisons. Method of analysis of Plant poisons, Method of analysis Mechanical poisons.

UNIT X

Toxicological analysis of decomposed materials. Interpretation of toxicological findings and preparation of reports, Forensic pharmacology, Pathways of poison/drug metabolism,

Forensic pharmacological studies, absorption, distribution, pharmacokinetics and metabolism, pathways of drug metabolism, drug toxicity, excretion of drugs and poisons. Detection of poison on the basis of their metabolic studies.

Submission of samples to the laboratory, postmortem examination, specific analysis plan / approach to toxicological examinations of poisoning samples.

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