TEERTHANKER MAHAVEER UNIVERSITY

(Established under Govt. of U.P. Act No. 30, 2008)
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SYLLABUS FOR TMU RESEARCH APTITUDE TEST IN MEDICAL SCIENCES

The syllabus for TMU Research Aptitude Test (TRAT) in 'Medical Sciences' is divided in two parts viz. Part A and Part B as described below:

PART – A

Part-A of the TRAT shall be designed to assess the research skills/aptitude of the candidate consisting of questions from the following areas:

1. **Research Methodology:** meaning, characteristics, and ethical issues in research; types of research; research methods.

2. **Logical Reasoning:** arguments, deductive and inductive research; logical and Venn diagram; inferences; analogies.

3. **Data Interpretation:** interpretation of data; mapping and analysis of data, tools for data analysis; quantitative and qualitative research.

4. **General Awareness about Basic Science:** basic science up to the level of SSC.

5. **Mathematical Reasoning:** number series, letter series, codes; relationships, classification.

PART – B

Part-B of TRAT is designed to assess the subject specific knowledge of the candidate and is further divided into two Sections viz. Section-I & Section-II. Section-I is common for all the candidates. From Section-II, a candidate is required to *select One Elective* paper out of the five elective papers viz. Physiology, Pharmacology, Biochemistry, Anatomy, and Microbiology.

SECTION – I

1. **Member structure and function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, iron channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
2. **Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
3. **Cellular communication:** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

4. **Innate and adaptive immune system:** Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, 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, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiency, vaccines.
5. **Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
6. **Cardiovascular System**: Comparative anatomy of hearth structure, myogenic heart, specialized tissue, ECG-its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.
7. **Respiratory system**: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
8. **Nervous system:** Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
9. **Sense organs:** Vision, hearing and tactile response.
10. **Excretory system:** Comparative physiology of excretion, kidney, urine formation, urin concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

SECTION – II
(ELECTIVES / OPTIONALS)

ELECTIVE-I (PHYSIOLOGY)

Cell Physiology

Cell Structure and membrane transport, Resting Membrane Potential, Composition of ECF and ICF, Nernst Equation, Equilibrium Potential, Goldmann Equation

Nerve-Muscle and Biopotential

Neuron (structure, function and classification), Neuroglia, Action Potential, Neuromuscular junction, Skeletal Muscle (structure, mechanism of contraction and relaxation), Smooth Muscle (structure, mechanism of contraction and relaxation)

Blood

Function and Composition, Erythrocytes, Haemoglobin, Blood groups, Leucocytes, Thrombocytes, Immunity

Cardiovascular System

Cardiac Muscle, Physiological anatomy of heart and conduction system, Cardiac Action Potential, Normal ECG, Cardiac cycle, Heart sounds, Cardiac output and blood pressure, Coronary circulation

Respiration

Functional anatomy of the respiratory system, Mechanism of breathing, Dead space, Surfactants

Dynamic and static lung volumes and capacities, Transport of oxygen and carbon dioxide, Regulation of Respiration, Cyanosis, Hypoxia, Oxygen toxicity

Excretory System
Function of kidney, Structure of nephron, Juxta glomerular apparatus, Formation of urine Counter current mechanism, Acidification of urine & role of kidney in maintenance of acid base balance, Renal function tests, Micturition

Autonomic Nervous System
Organization of the ANS, Chemo-transmitters, Effect of sympathetic and parasympathetic stimuli on different organ systems

Special Senses
Eye (functional anatomy, refractory indices of media, rods and cones, role of vitamin A, visual pathway), Ear (structure of internal ear, mechanism of hearing), Taste (distribution and structure of taste buds and taste papillae, primary taste modalities, taste pathway), Smell (olfactory epithelium and pathway)

Endocrine System
Mechanism of action of hormones, Functions of the following glands: Pituitary, thyroid, parathyroid, adrenal (cortex and medulla), pancreas

Skin and Temperature Regulation
Structure and function of skin, Body temperature- shell and core temperature and their variation

Regulation of body temperature, Anterior and posterior hypothalamus, Adaptation to cold and hot weather, Heat stroke

Reproductive System
Physiological anatomy of male and female reproductive system,
Embryological differentiation of male female reproductive organs, Karyosome, male and female chromosomes and diseases due dysjuntion of sex chromosomes, Male sex hormones- secretion, transport, biological action and mechanism of action, regulation of secretion, Female hormonessecretion, transport, biological action and mechanism of action, Pituitary-gonadal axis, ovarian and menstrual cycle, Physiology of pregnancy, parturition and lactation, Family planning-methods, indication and practice

ELECTIVE-II (PHARMACOLOGY)

1. **General Pharmacology:**

- Definition nature and sources of drugs, dosage forms, drug nomenclature, complimentary alternative medicine
- Routes of drug administration
- Pharmacokinetics: absorption, distribution, metabolism, excretion
- Pharmacodynamics: Principles of drug action, mechanism of drug action, Receptors, Agonist, partial agonist, inverse agonist, dose-response relationship, drug efficacy and potency, therapeutic index, LD 50 & ED 50, synergism, drug antagonism
- Rational drug concept: P drugs, essential drugs, evidence based medicine, pharmacovigilance, pharmacoeconomics and drug information
- Adverse drug reactions
- Drug interactions
- Fixed dose combinations

2. **Systemic Pharmacology:**

- Autonomic nervous system
- Central nervous system
- Autacoids
- Drugs affecting kidney function and cardiovascular system
- Drugs affecting gastrointestinal and respiratory system
- Drugs affecting uterine motility
- Chemotherapy of parasite infections
- Chemotherapy of microbial diseases
- Antineoplastic agents
- Immunomodulators
- Drugs acting on blood and blood forming organs
- Vitamins (water soluble and fat soluble vitamins).
- Heavy metals and heavy metal antagonists.
- Ocular and dermato-pharmacology.
- Free radical biology and antioxidants
- Drugs affecting Endocrine system

3. **Clinical Pharmacokinetics & Recent Advances:**

- Drug regulations: Drugs and Cosmetics Act, Drug Price Control Order
- Application for investigational new drug (IND), application for new drug discovery (NDD) according to Indian control authority and USFDA guidelines
- Conducting bio-equivalence studies
- Ethical considerations in utilizing human subjects for drug discovery process
- Helsinki's declaration
- ICH-GCP Guideline
- Ethical guidelines in utilizing animals for experimental purposes
- Therapeutic drug monitoring

ELECTIVE-III (ANATOMY)

Upper Limb
Pectoral region with breast, axilla and its contents, muscles of back and scapular region, comprehensive knowledge of structures in arm, forearm and hand, various joints with details of morphology

Lower Limb
Comprehensive knowledge of structures in thigh, gluteal region, leg and foot, arches of foot with anomalies, various joints with details of morphology

Thorax
Thoracic cage and intercostal spaces, pleura and lungs, pericardium and heart, structures in the posterior mediastinum

Abdomen & Pelvis
Morphology of abdominal wall, inguinal region & herniae, peritoneum – disposition and applied aspect, G.I.T. with associated glands, urinary system, internal and external genitalia, important endocrinal glands

Head, Neck, & face

Scalp, face, and neck, various salivary glands, various endocrine glands, cranial cavity and its contents, temporo mandibular joints, anatomy and contents of orbit, middle ear and nasal cavity, all cranial nerves & great vessels, larynx

Neuro Anatomy

Development and subdivisions of C.N.S., anatomical and functional classification of cerebral cortex, white matter viz. internal capsule, carpus callosum etc., relations and connections of diencephalon, limbic system, blood supply of brain & spinal cord, sectional neuroanatomy

Principles of Genetics, General & Systemic Histology & Embryology.

ELECTIVE-IV (MICROBIOLOGY)

General Microbiology

History of microbiology, microscopy and morphology of bacteria. growth, nutrition and bacterial metabolism, sterilisation and disinfection, bacterial genetics and variation, antimicrobial chemotherapy

Immunology

Anatomy, development and functions of immune system, microbial pathogenecity, toxins and host immune response, infection and immunity, antigen , antibodies and antigen antibody reactions, hypersensitivity and complement reaction, vaccine and immunization

Systemic bacteriology

Properties ,epidemiology, transmission, methods of isolation, identification , pathogenesis, toxins and enzyme production, clinical importance and laboratory diagnosis of the pathogenic bacteria - staphylococcus and streptococcus, neisseria, corynebacterium and clostridium, enterobacteriaciae, vibrio, salmonalla, pseudomonas, mycobacterium tuberculosis, mycobacterium leprae, spirocheate, helicobacter

Virology

General properties, classification and methods of cultivation, orthomyxovirus, enterovirus, rabies virus, hepatitis virus, human immunodeficiency virus, oncogenic viruses

Mycology

Morphology, cultivation, transmission, clinical importance and laboratory diagnosis of yeasts, yeast like fungi and dimorphic fungi, opportunistic fungal infections and mycotoxins

Parasitology

Transmission, clinical features and prevention of medically important protozoa, cestodes, trematodes and nematodes

Clinical Microbiology

Quality control in microbiology laboratory, hospital acquired infection, sore throat and respiratory infections, urinary tract infection, food poisoning, gastroenteritis and diarrhoeal diseases, sexually transmitted diseases, rapid diagnostic methods in microbiology, DNA amplification techniques, PCR and ELISA