

Revised Syllabus
For
D.D.T.
Diploma in Dialysis Technology



**LAL BAHADUR SHASTRI HEALTH SCIENCES
AND TECHNICAL COUNCIL, INDIA**

लाल बहादुर शास्त्री आरोग्य विज्ञान एवं प्राविधिक परिषद, भारत

मुख्य कार्यालय : 4वीं मंजिल, प्राइम प्लाजा, इंदरा नगर, लखनऊ

प्रशासनिक कार्यालय : द्वितीय तल, सुनील कम्पलेक्स, वेस्टर्न कचेरी रोड, मेरठ

वेबसाइट – www.lbspstc.in संपर्क सूत्र –121-4349311

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Syllabus Of “D.D.T. ” Diploma in Dialysis Technology

First Year (1st Year)

S.NO	Subject	Distribution Of Mark			
		TH	PR	Viva -Voce	Total
DDT-101	Human Anatomy & Physiology	100	-	-	100
DDT-102	Basic Pathology & Microbiology	100	-	-	100
DDT-103	Principles of Dialysis	100	-	-	100
DDT-104	Dialysis Machine & Equipment	100	-	-	100
DDT-105	Practical - I (Basic Clinical Skills & Dialysis Setup)	-	100	-	100
	Total	-	-	-	500

Second Year (2nd Year)

S.NO	Subject	Distribution Of Mark			
		TH	PR	Viva -Voce	Total
DDT-201	Clinical Issues with Hemodialysis	100	-	-	100
DDT-202	Doses of Dialysis	100	-	-	100
DDT-203	Continuous Dialysis	100	-	-	100
DDT-204	Peritoneal Dialysis with Special Dialysis Procedure	100	-	-	100
DDT-205	PRAC I (Advanced Practical, Clinical Dialysis & Viva)	-	100	-	100
	Total	-	-	-	500

First Year (1st Year)

➤ DDT-101 – HUMAN ANATOMY & PHYSIOLOGY

Unit 1 – Organization of Human Body & Cytology: Structural organization of human body, cellular organelles, transport across cell membranes (Diffusion, Osmosis, Active transport), body fluids and compartments (Intracellular and Extracellular fluids).

Unit 2 – Anatomy of the Renal System: Macroscopic anatomy and relations of kidneys, renal capsule, cortex, medulla, renal pyramids, calyces, renal pelvis, ureters, urinary bladder, and urethra.

Unit 3 – Microscopic Structure of Nephron: Detailed histology and ultrastructure of nephron (Glomerulus, Bowman's capsule, Proximal Convolved Tubule, Loop of Henle, Distal Convolved Tubule, Collecting Duct), and Juxtaglomerular apparatus (JGA).

Unit 4 – Renal Physiology & Urine Formation: Glomerular Filtration Rate (GFR), filtration fraction, tubular reabsorption, tubular secretion, counter-current mechanism of urine concentration, and clearance tests (Creatinine and Urea clearance).

Unit 5 – Fluid, Electrolyte & Acid-Base Balance: Regulation of sodium, potassium, calcium, phosphate, and magnesium balance; buffer systems of body (Bicarbonate, Phosphate, Protein buffers); renal regulation of systemic acid-base equilibrium and arterial blood gas (ABG) basics.

Unit 6 – Endocrine Functions of the Kidney: Renin-Angiotensin-Aldosterone System (RAAS) and blood pressure regulation; Erythropoietin secretion and erythropoiesis; Vitamin D activation (1,25-dihydroxycholecalciferol) and calcium metabolism.

Unit 7 – Cardiovascular System & Hemodynamics: Anatomy of heart, coronary circulation, systemic and pulmonary vascular beds; cardiac cycle, blood pressure determinants, peripheral vascular resistance, venous return, and access hemodynamics.

Unit 8 – Respiratory & Digestive Systems: Respiratory tract anatomy, alveolar gas exchange, oxygen and carbon dioxide transport; basic digestive tract anatomy, liver functions, portal circulation, and metabolism of nitrogenous wastes.

Unit 9 – Endocrine & Nervous System Overview: Pituitary gland, parathyroid glands and renal osteodystrophy pathogenesis, adrenal glands, autonomic nervous system regulation of cardiovascular tone.

Unit 10 – Pathophysiology of Renal Failure: Acute Kidney Injury (AKI) - prerenal, intrinsic renal, postrenal causes; stages of Chronic Kidney Disease (CKD), uremic syndrome, systemic manifestations of uremia on cardiovascular, nervous, and haematological systems.

➤ **DDT-102 – BASIC PATHOLOGY & MICROBIOLOGY**

Unit 1 – General Pathology Principles: Cellular injury, causes (ischemia, toxins, hypoxia), cellular adaptation, necrosis, apoptosis, acute and chronic inflammation, wound healing, edema, and shock.

Unit 2 – Renal Pathology & Glomerular Diseases: Etiology, clinical features, and pathology of Acute Glomerulonephritis, Nephrotic Syndrome, Chronic Glomerulonephritis, Diabetic Nephropathy, Hypertensive Nephrosclerosis, and Polycystic Kidney Disease (PKD).

Unit 3 – Tubular, Interstitial & Vascular Renal Diseases: Acute Tubular Necrosis (ATN), Acute Interstitial Nephritis, Pyelonephritis (Acute and Chronic), Renal Artery Stenosis, and Renal Infarction.

Unit 4 – Clinical Haematology in Renal Disease: Normocytic normochromic anaemia of CKD, bleeding diathesis in uremia, platelet dysfunction, collection and preservation of blood samples, Complete Blood Count (CBC), ESR, and peripheral blood smear.

Unit 5 – Clinical Biochemistry & Renal Function Tests (RFT): Estimation and clinical interpretation of Blood Urea, Serum Creatinine, Blood Urea Nitrogen (BUN), Serum Uric Acid, Serum Electrolytes (Na⁺, K⁺, Cl⁻, HCO₃⁻), Calcium, Phosphorus, Alkaline Phosphatase, Serum Albumin, and Lipid Profile.

Unit 6 – Urinalysis & Proteinuria Evaluation: Physical examination of urine (Color, Turbidity, Specific gravity), Chemical testing (Dipstick for Protein, Glucose, Ketones, Blood), Microscopic examination for Casts (Hyaline, Granular, RBC, WBC casts), Crystals, RBCs, and 24-hour urinary protein estimation.

Unit 7 – Fundamentals of Medical Microbiology: Morphology, classification, and physiology of bacteria, viruses, and fungi; Gram staining and acid-fast staining; normal bacterial flora of skin and mucous membranes.

Unit 8 – Blood-Borne Viral Infections in Dialysis Unit: Hepatitis B Virus (HBV - HBsAg, Anti-HBs), Hepatitis C Virus (HCV - Anti-HCV, HCV-RNA), and Human Immunodeficiency Virus (HIV); transmission routes, screening protocols, vaccination schedules, and isolation policies.

Unit 9 – Sterilization, Disinfection & Water Microbiology: Physical and chemical sterilization methods (Autoclaving, ETO, Chemical disinfectants); microbiological testing of dialysate and RO water (Endotoxin/LAL test, Colony-forming units / CFU limits, AAMI/ISO standards).

Unit 10 – Dialysis-Related Infections & Biomedical Waste: Vascular access infections (AV fistula cellulitis, catheter-related bloodstream infections / CRBSI), exit-site infections, peritonitis in peritoneal dialysis, hospital-acquired infections (HAI), and BMW segregation rules (Yellow, Red, Blue, White bins).

➤ **DDT-103 – PRINCIPLES OF DIALYSIS**

Unit 1 – History & Evolution of Dialysis: Historical milestones in artificial kidney development, Willem Kolff's rotating drum, development of hollow fiber dialyzers, and evolution of modern dialysis modalities.

Unit 2 – Physical & Chemical Principles of Dialysis: Diffusion (Fick's law of diffusion, concentration gradient, solute molecular weight, membrane surface area, temperature), Osmosis and Osmotic pressure, Ultrafiltration (Hydrostatic pressure, Transmembrane pressure / TMP), Convection (Solute drag), and Adsorption.

Unit 3 – Dialyzer Structure & Membrane Characteristics: Hollow fiber dialyzer geometry, potting material, housing, blood compartment, dialysate compartment; classification of membranes (Cellulosic, Modified cellulosic, Synthetic like Polysulfone, Polymethylmethacrylate, Polyacrylonitrile, Polyethersulfone), biocompatibility, flux characteristics (Low-flux vs High-flux), sieving coefficient, and clearance (KoA).

Unit 4 – Composition & Chemistry of Dialysate: Function and chemical composition of dialysate (Sodium, Potassium, Calcium, Magnesium, Chloride, Bicarbonate buffer, Acetate buffer, Glucose); preparation of Part A (Acid concentrate) and Part B (Bicarbonate concentrate); dialysate conductivity and temperature control.

Unit 5 – Anticoagulation in Hemodialysis: Coagulation cascade activation during extracorporeal blood flow; Unfractionated Heparin protocols (Bolus and continuous infusion), Low Molecular Weight Heparin (LMWH), Heparin-free dialysis (Saline flushes), Regional Citrate Anticoagulation (RCA), monitoring Activated Clotting Time (ACT).

Unit 6 – Vascular Access for Hemodialysis (Overview): Types of vascular access: Temporary and Tunneled Cuffed Central Venous Catheters (Internal Jugular, Femoral, Subclavian); Arteriovenous Fistula (AVF - Radiocephalic, Brachiocephalic, Brachio basilic); Arteriovenous Graft (AVG); maturation, physical assessment (Bruit, Thrill).

Unit 7 – Hemodialysis Procedure Setup & Priming: Preparation of extracorporeal circuit, arterial and venous blood lines, dialyzer mounting, saline priming, heparinization of circuit, transducer protectors, air detector priming, and pre-dialysis check.

Unit 8 – Patient Assessment & Vital Sign Monitoring: Pre-dialysis clinical evaluation, assessment of dry weight, target ultrafiltration calculation (interdialytic weight gain / IDWG), recording pre-, intra-, and post-dialysis vital signs (BP, Pulse, Respiration, Temperature, Oxygen saturation).

Unit 9 – Cannulation Techniques & Vascular Access Care: Aseptic skin preparation, needle selection (14G, 15G, 16G, 17G), cannulation techniques (Rope ladder, Buttonhole, Area puncture), bevel orientation, angle of insertion, securing needles, post-dialysis hemostasis, and fistula care education.

Unit 10 – Dialyzer Reprocessing & Reuse Protocols: Rationale and safety of dialyzer reuse; manual vs automated dialyzer reprocessing; cleaning agents (Hydrogen peroxide, Peracetic acid, Renalin, Bleach, Formalin); Total Cell Volume (TCV) / Fiber Bundle Volume

measurement, membrane pressure leak testing, disinfectant storage, labelling, and pre-use residual disinfectant testing.

➤ **DDT-104 – DIALYSIS MACHINE & EQUIPMENT**

Unit 1 – Overview & Architecture of Hemodialysis Machine: Functional modules of hemodialysis machine: Extracorporeal Blood Circuit system, Dialysate Delivery system, Hydraulic system, Electronic control system, User interface and display monitor.

Unit 2 – Extracorporeal Blood Circuit Components: Peristaltic roller blood pump (mechanism, calibration, flow rate calculation), Arterial pressure monitoring line and transducer, Venous drip chamber, Venous pressure transducer, Air bubble detector (ultrasonic principle), Venous line clamp, Heparin infusion pump, Blood leak detector (optical sensor).

Unit 3 – Dialysate Proportioning & Mixing System: Dynamic proportioning systems, conductivity-based feedback mixing of acid and bicarbonate concentrates, water intake regulator, proportioning pumps, degasser system (de-aeration chamber and vacuum pump).

Unit 4 – Temperature & Conductivity Monitoring: Dialysate heating unit, thermistors, temperature control alarms (hypothermia and hyperthermia prevention), dual-conductivity sensors, temperature-compensated conductivity calculation, bypass valve operation during conductivity alarms.

Unit 5 – Ultrafiltration Control Systems: Volumetric ultrafiltration control system (balancing chambers / flow sensors), Transmembrane Pressure (TMP) calculation and servo-control mechanism, profiling capabilities (Ultrafiltration profiling and Sodium profiling).

Unit 6 – Safety Alarms & Interlocks: Causes, mechanisms, and corrective actions for Blood side alarms (High/low arterial pressure, High/low venous pressure, Air detector alarm, Blood leak alarm) and Dialysate side alarms (Conductivity high/low, Temperature high/low, Dialysate pressure alarm, Low water supply alarm).

Unit 7 – Disinfection & Cleaning of Dialysis Machine: Chemical disinfection protocols (Citric acid, Peracetic acid, Sodium hypochlorite), Thermal / Heat disinfection cycles, rinse cycles, decalcification, preventive maintenance schedules, and electrical safety standards.

Unit 8 – Water Treatment System for Hemodialysis (RO Plant): Importance of water quality in dialysis; Raw water storage, Booster pumps, Multi-media depth filter (Sand filter), Activated Carbon filter (chlorine and chloramine removal), Water Softener (Resin bed, brine tank, water hardness testing).

Unit 9 – Reverse Osmosis (RO) Unit & Distribution Loop: Micron cartridge pre-filters (5 micron, 1 micron), High-pressure pump, Semi-permeable RO membranes (Thin-film composite), Permeate vs reject flow, Deionizer (DI) beds, Ultra-violet (UV) irradiation, Endotoxin / Ultrafilter, Direct feed vs Indirect storage loop (PEX/PVDF piping, dead legs prevention).

Unit 10 – Water Quality Standards & Monitoring: AAMI (Association for the Advancement of Medical Instrumentation) and ISO 13959 water quality standards; chemical contaminant limits (Aluminum, Chloramines, Fluoride, Nitrates, Copper, Zinc, Heavy metals); microbiological monitoring (Total viable counts, Endotoxin levels via LAL assay), and chemical disinfection of RO plant.

➤ **DDT-105 – PRACTICAL - I (BASIC CLINICAL SKILLS & DIALYSIS SETUP)**

Unit 1 – Dialysis Unit Orientation & Infection Control: Orientation to hemodialysis unit layout, isolation rooms for hepatitis/HIV patients, hand hygiene demonstration, donning and doffing of PPE, biomedical waste disposal.

Unit 2 – Pre-Dialysis Machine Preparation & Testing: Connecting water inlet, drain lines, acid and bicarbonate concentrate canisters, powering on machine, passing automatic hydraulic and self-test diagnostic cycles.

Unit 3 – Extracorporeal Circuit Priming & Setup: Aseptic mounting of dialyzer, threading arterial and venous blood lines through blood pump, drip chambers, level sensors, and heparin line; priming circuit with Normal Saline; bubble removal.

Unit 4 – Patient Assessment & Vital Signs Recording: Measuring pre-dialysis weight, calculation of fluid removal target (UF goal), recording blood pressure, pulse, temperature, respiration, and inspecting AV fistula for thrill and bruit.

Unit 5 – Aseptic Cannulation & Connection Practice: Simulated/supervised aseptic skin disinfection, cannulation of AV fistula using 15G/16G needles, connecting blood tubing, establishing blood flow, securing needles with tape.

Unit 6 – Central Venous Catheter Care & Connection: Sterile dressing removal, catheter hub disinfection (Chlorhexidine/Betadine), aspirating heparin lock, checking catheter patency, connecting to blood lines, and re-locking catheter post-dialysis (Heparin/Citrate lock).

Unit 7 – Intra-Dialysis Monitoring & Charting: Recording hourly parameters on dialysis flowsheet (Blood Flow Rate / Qb, Dialysate Flow Rate / Qd, Arterial pressure, Venous pressure, TMP, Cumulative UF volume, BP, Pulse).

Unit 8 – Dialyzer Reprocessing Hands-On: Manual and automated dialyzer washing, measuring bundle volume (TCV), pressure leak test, filling with disinfectant (Peracetic acid), labelling, and pre-dialysis residual chemical testing.

Unit 9 – Termination of Dialysis & Access Care: Rinsing back blood with sterile saline (Washback), stopping blood pump, removing fistula needles, applying localized pressure with sterile gauze, monitoring hemostasis, applying dressing bandage, and post-dialysis weight recording.

Unit 10 – Dialysis Unit Logbook & Practical Assessment: Maintenance of daily dialysis case logbook, record of cannulations, machine disinfection records, and evaluation of technical competence through viva-voce.

Second Year (2nd Year)

➤ DDT-201 – CLINICAL ISSUES WITH HEMODIALYSIS

Unit 1 – Intra-Dialytic Hypotension (IDH): Pathophysiology, incidence, risk factors (Excessive ultrafiltration, autonomic neuropathy, food intake during dialysis, low dialysate sodium/temperature); clinical signs, immediate bedside management (Trendelenburg position, saline bolus, stopping UF, oxygen), and long-term prevention strategies.

Unit 2 – Muscle Cramps & Dialysis Disequilibrium Syndrome (DDS): Pathogenesis of muscle cramps (Rapid fluid removal, hypomagnesemia, hyponatremia), treatment (Hypertonic saline/dextrose, massage); Dialysis Disequilibrium Syndrome (mechanism, cerebral edema, headache, nausea, confusion, seizures, prevention during first dialysis initiation).

Unit 3 – Nausea, Vomiting, Headache & Chest Pain: Etiology, differential diagnosis, and management of intra-dialytic nausea, vomiting, headache, chest pain (angina vs hemolysis vs air embolism), and cardiac arrhythmias.

Unit 4 – Hypersensitivity & First-Use Syndrome: Type A (Anaphylactoid reaction - ETO, dialyzer membrane, severe shock, bronchospasm, immediate line clamping without blood rinseback) and Type B (Chest/back pain, complement activation); recognition and management.

Unit 5 – Air Embolism & Hemolysis in Hemodialysis: Air embolism (causes, venous line detachment, entry of air, signs, immediate clamp-and-turn maneuver — Left lateral Trendelenburg position / Durant maneuver, 100% O₂); Hemolysis (causes: kinking, overheated dialysate, hypo-osmolar dialysate, chloramine toxicity; signs: port-wine blood color, acute backache; emergency protocols).

Unit 6 – Vascular Access Complications & Troubleshooting: Vascular access thrombosis (declotting protocols), stenosis, aneurysm and pseudoaneurysm, steal syndrome, recirculation, access infection (Staph aureus bacteremia, metastatic abscesses), and access surveillance (Transonic flow, dynamic venous pressure).

Unit 7 – Cardiovascular Complications in Dialysis Patients: Left ventricular hypertrophy (LVH), congestive heart failure, fluid overload, pulmonary edema emergency, coronary artery disease, sudden cardiac death, pericarditis (Uremic pericarditis and hemorrhagic pericardial effusion).

Unit 8 – Mineral Bone Disorder (CKD-MBD) & Anemia: Pathogenesis of secondary hyperparathyroidism, adynamic bone disease, vascular calcification, management with

phosphate binders and Calcimimetics; evaluation and management of renal anemia with Erythropoietin Stimulating Agents (ESA) and intravenous Iron therapy.

Unit 9 – Bleeding Disorders & Heparin Complications: Uremic platelet dysfunction, gastrointestinal bleeding, subdural hematoma, Heparin-Induced Thrombocytopenia (HIT Type 1 and Type 2), management of post-dialysis prolonged puncture bleeding.

Unit 10 – Dialysis in Special Populations & Emergencies: Hemodialysis in paediatric patients, elderly frail patients, pregnant patients with CKD, diabetic nephropathy, and acute poisoning / drug overdose (dialyzable toxins: Salicylates, Methanol, Ethylene glycol, Lithium, Theophylline).

➤ **DDT-202 – DOSES OF DIALYSIS**

Unit 1 – Concept & Importance of Dialysis Adequacy: Definition of dialysis dose, relationship between delivered dose and patient morbidity/mortality, targets recommended by KDOQI (Kidney Disease Outcomes Quality Initiative) and KDIGO guidelines.

Unit 2 – Urea Kinetic Modeling (UKM): Single-pool variable-volume UKM (spKt/V), Double-pool UKM (equilibrated Kt/V / eKt/V), Urea distribution volume (V - Watson formula, bioimpedance), and Protein Catabolic Rate (nPCR / nPNA).

Unit 3 – Mathematical Concepts: Kt/V and URR: Calculation and derivation of Kt/V (Clearance × Time / Volume); Urea Reduction Ratio ($URR = [Pre-BUN - Post-BUN] / Pre-BUN \times 100\%$); minimum target goals ($URR \geq 65-70\%$, $spKt/V \geq 1.2$ to 1.4 per session).

Unit 4 – Factors Affecting Dialyzer Clearance (K): Blood flow rate (Q_b), Dialysate flow rate (Q_d), dialyzer mass transfer area coefficient (KoA), membrane surface area, concentration gradient, and dialyzer clotting/loss of fiber volume.

Unit 5 – Treatment Time (t) & Dialysis Frequency: Effect of treatment duration on middle molecule clearance (Beta-2 Microglobulin), ultrafiltration rate (UFR ml/kg/hr), twice-weekly vs thrice-weekly regimens, daily hemodialysis, and nocturnal hemodialysis.

Unit 6 – Blood Sampling Techniques for Pre & Post-BUN: Standardized blood sampling protocols; avoiding dilution in Pre-BUN; Post-BUN sampling techniques (Slow Flow / Stop Flow technique, Arterial port sampling) to prevent access recirculation and cardiopulmonary recirculation artifact.

Unit 7 – Vascular Access Recirculation Measurement: Causes of recirculation (Access stenosis, reverse needle placement); clinical calculation using 3-sample urea method (Systemic arterial, Pre-dialyzer arterial, Post-dialyzer venous samples) and saline dilution method.

Unit 8 – Residual Renal Function (RRF) & Incremental Dialysis: Measurement of residual GFR (Average of 24-hour urea and creatinine clearance), importance of preserving RRF in dialysis patients, and concepts of incremental hemodialysis prescription.

Unit 9 – Troubleshooting Under-Dialysis: Clinical signs of inadequate dialysis (Loss of appetite, weight loss, pruritus, fatigue, pericardial friction rub); algorithmic approach to correcting low delivered Kt/V (adjusting needle size, optimizing Qb, increasing Qd, changing dialyzer, increasing treatment time).

Unit 10 – Dialysis Prescription Formulation & Record Keeping: Writing comprehensive hemodialysis prescription (Dialyzer model, dry weight, treatment time, Qb, Qd, dialysate sodium/bicarbonate, heparin regimen, target UF, temperature, profiling), and computerized clinical data recording.

➤ **DDT-203 – CONTINUOUS DIALYSIS**

Unit 1 – Introduction to Continuous Renal Replacement Therapy (CRRT): Definition, physiological rationale, historical development, comparison between Intermittent Hemodialysis (IHD) and CRRT in critically ill ICU patients with hemodynamic instability.

Unit 2 – Indications & Patient Selection for CRRT: Severe Acute Kidney Injury (AKI) in ICU with septic shock, multiple organ dysfunction syndrome (MODS), acute cerebral edema/traumatic brain injury, severe fluid overload refractory to diuretics, acute pancreatitis, severe metabolic acidosis, and lactic acidosis.

Unit 3 – CRRT Modalities & Physical Principles: Slow Continuous Ultrafiltration (SCUF - fluid removal only), Continuous Veno-Venous Hemofiltration (CVVH - convective clearance), Continuous Veno-Venous Hemodialysis (CVVHD - diffusive clearance), and Continuous Veno-Venous Hemodiafiltration (CVVHDF - combined diffusion and convection).

Unit 4 – CRRT Circuit Components & Hardware: Specialized CRRT machine platform, multi-pump system (Blood pump, Pre-blood replacement pump, Post-blood replacement pump, Dialysate pump, Effluent pump), highly permeable synthetic hemofilters (Polysulfone/AN69), and air/pressure sensors.

Unit 5 – Replacement & Substitution Fluids: Fluid balance calculation; composition of replacement solutions (Bicarbonate-buffered vs Lactate-buffered); Pre-dilution vs Post-dilution fluid infusion (advantages on filter lifespan and solute clearance), and effluent volume dosing (ml/kg/hr).

Unit 6 – Anticoagulation Strategies in CRRT: Regional Citrate Anticoagulation (RCA - mechanism, calcium chelation, post-filter ionized calcium monitoring, systemic calcium gluconate/chloride infusion, risk of citrate toxicity/gap metabolic acidosis), Unfractionated Heparin, and Heparin-free CRRT protocols.

Unit 7 – Sustained Low-Efficiency Dialysis (SLED / SLEDD): Principles of SLED / SLEDD-F, operational parameters (Qb 150-200 ml/min, Qd 100-300 ml/min, duration 6-12 hours), clinical advantages of SLED as an economic and effective hybrid therapy in ICU.

Unit 8 – Vascular Access & Catheter Care in CRRT: Temporary dual-lumen non-cuffed central venous catheters (Femoral, Internal Jugular), catheter length and size selection (11.5F to 14F), preventing catheter kinking, recirculation, and CRBSI prophylaxis.

Unit 9 – Troubleshooting CRRT Circuit & Filter Clotting: High access pressure, high return pressure, high transmembrane pressure (TMP), filter clotting warning signs, membrane fouling, adjusting filtration fraction ($FF < 20\text{-}25\%$), and emergency circuit changeover.

Unit 10 – Nursing Care, Fluid Balance & Nutritional Support in CRRT: Hourly fluid balance calculation, electrolyte replacement (potassium, phosphate, magnesium supplementation), amino acid/protein loss compensation in CRRT, and patient safety protocols.

➤ **DDT-204 – PERITONEAL DIALYSIS WITH SPECIAL DIALYSIS PROCEDURE**

Unit 1 – Anatomy & Physiology of Peritoneal Membrane: Peritoneal cavity, parietal and visceral peritoneum, peritoneal blood supply, Three-Pore Model of peritoneal permeability (Large pores, Small pores, Ultrasmall aquaporin-1 water channels), Solute transport mechanisms (Diffusion, Convection, Lymphatic absorption).

Unit 2 – Peritoneal Dialysis Catheters & Implantation: Types of PD catheters (Tenckhoff straight and coiled, Swan-neck, Toronto Western), catheter components (Silicone tubing, Dacron cuffs), surgical and percutaneous bedside insertion techniques, break-in period, exit site healing, and catheter flushing.

Unit 3 – Composition of Peritoneal Dialysis Solutions: Chemical composition of PD fluid (Dextrose concentrations: 1.5%, 2.5%, 4.25%; Sodium, Calcium, Magnesium, Chloride, Lactate buffer); Non-glucose based osmotic agents (Icodextrin / Extraneal for long dwell, Amino acid-based solutions).

Unit 4 – Modalities of Peritoneal Dialysis: Continuous Ambulatory Peritoneal Dialysis (CAPD - manual exchange procedure, fill, dwell, drain phases); Automated Peritoneal Dialysis (APD / Cycler machine - Continuous Cycling PD / CCPD, Intermittent PD / IPD, Tidal PD / TPD).

Unit 5 – Peritoneal Equilibration Test (PET) & Adequacy in PD: Standardized PET protocol (4-hour dwell test), D/P Creatinine ratio, D/D₀ Glucose ratio, categorization of membrane transport status (High, High-average, Low-average, Low transporter); calculating weekly peritoneal and total Kt/V (target ≥ 1.7).

Unit 6 – Complications of Peritoneal Dialysis: Infectious complications: PD Peritonitis (clinical features: cloudy effluent, abdominal pain; diagnostic criteria: WBC $> 100/\mu\text{L}$ with $> 50\%$ neutrophils; empiric intraperitoneal antibiotic protocols), Exit-site and Tunnel infections; Non-infectious complications: Catheter tip migration, catheter leak, dialysate leak, hernia, hydrothorax, Encapsulating Peritoneal Sclerosis (EPS).

Unit 7 – Therapeutic Plasma Exchange (Plasmapheresis / TPE): Principles of plasma separation (Centrifugation vs Membrane filtration), indications (Guillain-Barré Syndrome, Myasthenia Gravis, TTP, Goodpasture syndrome, Renal transplant antibody-mediated rejection), replacement fluids (5% Human Albumin, Fresh Frozen Plasma), anticoagulation, and complications.

Unit 8 – Hemoperfusion & Extracorporeal Toxin Removal: Principles of hemoperfusion; sorbent cartridges (Activated charcoal, Amberlite resins); indications in acute poisoning (Barbiturates, Theophylline, Paraquat, Organophosphates), cartridge saturation, and thrombocytopenia monitoring.

Unit 9 – Molecular Adsorbent Recirculating System (MARS) & Liver Dialysis: Principles of albumin dialysis for acute liver failure / hepatorenal syndrome; removal of albumin-bound toxins (Bilirubin, Bile acids, Aromatic amino acids) and water-soluble toxins.

Unit 10 – Hemodiafiltration (Online HDF): Principles of Online High-Volume Hemodiafiltration; generation of ultrapure substitution fluid online, post-dilution vs pre-dilution HDF, convective volume optimization (> 23 Liters/session), clinical benefits on cardiovascular mortality and middle molecule clearance.

➤ **DDT-205 – PRAC I (ADVANCED PRACTICAL, CLINICAL DIALYSIS & VIVA)**

Unit 1 – Advanced Hemodialysis Machine Setup & Calibration: Complete setup, priming, profiling (Sodium profiling and UF profiling), calibration of blood pump, conductivity and temperature verification, troubleshooting simulated machine alarms.

Unit 2 – Difficult Vascular Access Management & Cannulation: Assessment of deep/tortuous fistulae, cannulation of difficult AV fistulae and grafts using touch technique, managing needle infiltration, and applying post-infiltration care.

Unit 3 – Management of Acute Intra-Dialytic Complications (Simulation): Bedside emergency management of acute intra-dialytic hypotension (saline bolus, Trendelenburg position), muscle cramps, severe rigor/chills, suspected air embolism, and acute hemolysis.

Unit 4 – Blood Sampling for Kt/V & Adequacy Calculation: Practical execution of Pre-BUN and Post-BUN blood sampling (Stop-Flow / Slow-Flow technique), performing URR and single-pool Kt/V calculations for clinical case files.

Unit 5 – CRRT Machine Priming, Setup & Operation in ICU: Assembling and priming CRRT hemofilter circuit, setting up citrate and calcium infusion lines, programming CVVH/CVVHD/CVVHDF prescription on CRRT console, monitoring hourly fluid balance.

Unit 6 – SLED / SLEDD Setup & Monitoring: Programming standard hemodialysis machine for low-efficiency sustained dialysis (low blood flow Q_b , low dialysate flow Q_d), connecting ICU patients, and monitoring hemodynamics.

Unit 7 – Peritoneal Dialysis (CAPD) Exchange Demonstration: Aseptic manual exchange procedure using twin-bag disconnect system (Drain, Flush, Fill phases), inspecting effluent clarity, and performing exit-site dressing care.

Unit 8 – Automated Peritoneal Dialysis (APD) Cyclor Programming: Setting up APD cyclor machine, cassette loading, line priming, programming therapy parameters (Total volume, dwell time, number of cycles, last bag fill), and downloading cyclor compliance cards.

Unit 9 – Therapeutic Plasma Exchange & Special Dialysis Setup: Setting up plasma filter / plasmapheresis circuit, managing replacement fluids (Albumin/FFP), monitoring transmembrane pressure, and operating Online HDF system.

Unit 10 – Clinical Internship Logbook, Case Studies & Grand Viva-Voce: Evaluation of 50 supervised clinical dialysis case records, emergency access management case studies, water treatment plant testing records, and comprehensive grand viva-voce.

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