

**SRI VENKATESWARA INSTITUTE OF MEDICAL SCIENCES**  
**TIRUPATI – 517 507**

*(A University established by an act of Andhra Pradesh State Legislature)*



**PG Programme in Allied Health Sciences**

**M.Sc DIALYSIS TECHNOLOGY COURSE**

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**TIRUMALA TIRUPATI DEVASTHANAMS**

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## General Regulations

### 1. Title of the Course

Master of Science degree in Dialysis Technology(M.Sc – DT)

### 2. Duration of the Course

The duration of the course shall be 2- years on full time basis

### 3. Eligibility for Admission

B. Sc in Dialysis Technology (4 yrs duration including one year internship)  
(or)

B. Sc in Dialysis Technology(3 yrs duration) with one year of experience in a teaching institute)

### 4. Selection Criteria

Selection shall be based on the academic merit/entrance test conducted in the qualifying exam.

### 5. Admission schedule :

a) Commencement of Course: In August during every year

b) The admissions are closed by 30<sup>th</sup> September or 60 days from the date of commencement of the programme.

### 6. Medium of instruction.

English shall be the medium of instruction for the subjects of study as well as for the Examination.

### 7. Course of study

The course shall be pursued on full time basis. In the end of first year, there shall be an examination. Students shall be posted in SVIMS and SPMC hospitals during the practical hours.

Subjects for study and teaching hours for first year and second year of the PG course is shown below.

### Distribution of Teaching Hours

#### FIRST YEAR – THEORY

S.No.	Main subject	Theory No. of Hours
1.	Basic Sciences in Nephrology *	200
2.	Clinical Nephrology	100
3.	Basic principles and overview of types of renal replacement therapies (HD & PD)	130
4.	Epidemiology & Biostatistics	60
5.	<b>Subsidiary subject:</b> Medical Ethics	10
	<b>Total:</b>	<b>500</b>

\*The attendance for the speciality subject shall be maintained by the HOD's i.e. Anatomy, Physiology, Pathology etc. Both University Theory and Practical will be evaluated by the Nephrologist and the expert.

## PRACTICALS

Sl. No.	Area of posting / Subject	Total no. of contact hours
1	Dialysis Room	430
2	Water treatment plant	50
3	Electronics, Plumbing , Computer	70
4	Management of Dialysis unit	50
5	ICU Side Dialysis	20
6	Peritoneal Dialysis	20
7	Special & advanced dialysis procedures	20
8	CPR Demo	10
9	Teaching Methodology	100
10	Groups Discussion	30
	<b>Total :</b>	<b>800</b>

## SECOND YEAR – THEORY

S.No.	Branches	Theory No. of Hours
6.	Recent advances in HD Procedures & complications in renal disease patients, Dialysis patients & Renal Nutrition	220
7.	Management of Dialysis Unit & Biomedical Instrumentation , Biotechnology & Molecular Biology	140
8.	Emergency Medicine, ACL, Nephro – Radiological and imaging sciences, Nuclear Medicine and Nephro-psychiatry	60
	<b>Total:</b>	<b>400</b>

## PRACTICALS

Sl. No.	Area of posting / Subject	Total no. of contact hours
1	Dialysis Room	400
2	Water treatment plant	20
3	Electronics, Plumbing , Computer	20
4	Management of Dialysis unit	100
5	ICU Side Dialysis	50
6	Peritoneal Dialysis	10
7	Special & advanced dialysis procedures	200
8	Teaching Methodology	300
9	Groups Discussion	20
10.	Machine Management	180
	<b>Total :</b>	<b>1300</b>

### 8 a) Attendance:

A candidate is required to put in minimum 80% of attendance both in theory and practical separately of each paper before admission to the university examination. Participation in NCC, NSS, sports and games, educational tours, professional meetings and conference or other co-curricular activities representing the institution/university will not count as absence.

**b) Condonation for lack of attendance:**

The condonation of attendance on medical grounds or on absence under extraordinary circumstances to those who are having the attendance between 70% and 79% in each paper will be granted in genuine cases. The students who have shortage of attendance in the particular papers have to apply to the controller of examinations, indicating the reasons for shortage of attendance. The representation to be forwarded by the HOD & Prof. i/c AHS. If the reason is on the medical grounds, the relevant medical certificate has to be enclosed to the representation. If any student falls below the 70% of attendance, he/she will not be allowed to write the university examinations.

**9. Scheme of examination**

- a) The examination for the degree shall consist of written papers, practical and oral.
- b) There shall be two examinations viz. Preliminary and final. The preliminary examination shall be taken at the end of the first year. The final examination shall be taken at the end of 2<sup>nd</sup> year.
- c) The examination shall be conducted ordinarily twice a year, viz. July/August and January/February.

**Preliminary Examination**

This consists of theory, practical and oral. There will be separate papers for each specialization.

**University Examination and Distribution of marks****FIRST YEAR**

S.No	Subjects	Paper	Theory		Practical (Marks)		Viva	Grand Total
			IA	UE	IA	UE		
1.	Basic Sciences in Nephrology	I	20	80	15	60	25	200
2.	Clinical Nephrology	II	20	80	15	60	25	200
3.	Basic principles and overview of types of renal replacement therapy (HD & PD)	III	20	80	15	60	25	200
4.	Epidemiology & biostatistics	IV	20	80		-	-	100
	<b>Total</b>							<b>700</b>

**SECOND YEAR**

S.No	Subjects	Paper	Theory		Practical (Marks)		Viva	Grand Total
			IA	UE	IA	UE		
5.	Recent advance HD Procedures & complications in renal disease patients Dialysis patients & Renal Nutrition	V	20	80	15	60	25	200
6.	Management of Dialysis Unit & Biomedical Instrumentation	VI	20	80	15	60	25	200

	Biotechnology & Molecular Biology							
7.	Emergency Medicine / ACL Nephro – Radiological, Nuclear Medicine and imaging sciences Nephro- psychiatry	VII	20	80	15	60	25	200
8.	Dissertation					100	50	150
	<b>Total</b>							<b>750</b>

### **Dissertation**

The student should submit dissertation one month before the final examination. Those students who have not submitted the dissertation shall not be allowed to appear for the final examination. The dissertation shall be assessed at the time of orals by all the examiners.

The dissertation shall be written under the following headings:

Introduction; Aims or objectives of study; Review of literature; Materials and methods  
Results; Discussion; Conclusion; Summary; References; Tables; Annexure

The written text of dissertation shall not be less than 50 pages and shall not exceed 100 pages excluding references, tables, questionnaires and other annexure. It should be neatly typed in double line spacing on one side of paper (A4 size, 8.27” x 11.69”) and bound properly. Spiral binding should not be done. A declaration by the candidate that the work was done by him/her shall be included. The guide and head of the department shall certify the bonafide of the dissertation.

Three copies of dissertation shall be submitted to the university through proper channel along with a soft copy (CD), one month before the final examinations.

### **10. Internal assessment (IA):**

- a) A student must secure at least 35% marks of the maximum marks fixed for internal assessment in a particular subject to be eligible to appear for the university examination of that subject.
- b) There shall be three internal assessment tests and the average of these tests shall be considered for awarding final marks.
- c) If the candidate is absent for any of the exams, the marks in that exam shall be taken as zero.
- d) The computed internal assessment marks as per the regulation 10 a) & b) shall be sent to the controller of exams 15 days before the commencement of the University exam.
- e) The internal assessment marks should be signed by the concerned teaching faculty or HOD and counter signed by the HOD before being forwarded to the Controller of Examinations.
- f) For those who failed in internal assessment test/s, have to reappear as per the regulation 9 a) & b) before he/she appears for the university examination.
- g) For those who want to improve their marks in internal assessment tests, they can appear again as per the regulation 9 a) & b). For such students, the internal assessment marks of the student at the time of first appearance will be compared with the marks obtained at the present appearance and the higher of the two will be taken as his/her internal assessment marks.

### **11. Minimum for a pass**

- a) 35% in internal assessment of each theory paper and practicals/viva voce
- b) 40% in each theory paper of university examination.
- c) 50% on the total marks of theory university examination and internal assessment clubbed together, applicable to each paper.

- d) Where, viva voce involved which is part of theory examination, 50% on the total marks of theory university examination, internal assessment and viva voce clubbed together, applicable to each paper.
- e) Where there is no internal assessment marks, 50% on the total theory marks, 50% in practicals/viva voce applicable to each subject.

Note: For 2 year PG course, where any paper contains both theory and practicals/viva voce, the student has to pass both theory and practicals/viva voce, if any student pass in theory examination and fail in practicals/viva voce examination or vice versa, the student concerned has to appear again for both theory and practicals/viva voce examination.

## **12. Classification of successful candidates**

### Percentage of Marks for declaring Class:

Distinction	- 75% and above of the total marks.
First Class	- 65 - 74% of the total marks.
Second Class	- 50- 64% of the total marks.
Pass Class	- If the student does not pass all the subjects within the duration of the course, the class will not be awarded and the final results will be declared as "Pass". Those who have break in the middle of the course due to attendance shortage, it will be taken into consideration as not completed within the duration of the course and the final results will be declared as "Pass".

## **13. Reappearance**

The student has to pass both theory and practicals/via voce, if any student pass in theory examination and fail in practicals/viva voce examination or vice versa, the concerned student has to appear again for both theory and practicals/viva voce examination.

## **14. Carry-over Provision**

The students are permitted to complete the course period irrespective of their success in the preliminary part. However, the final results will be kept under "withheld" until he/she passes all the previous papers".

## **15. Maximum duration for completion of course**

A candidate shall complete the course within four years from date of admission. Failing which, the candidate will be discharged.

## **16. Eligibility for award of degree**

A candidate shall have passed in all the subjects of first and second year to be eligible for award of degree.

# FIRST YEAR

## Course content (Syllabus) Theory

### **Paper I: Basic Sciences in Nephrology**

- I. Anatomy of Urinary Tract & Kidney (30hrs)**
1. Gross anatomy of the kidney (6hrs)
- Location of kidney
  - Size
  - Protection
  - Structure of the kidney – gross structure blood supply, nerve supply, lymphatic flow, L.S of Kidney.
2. Basic anatomy of urinary system (8hrs)
- The Kidney (structural anatomy)
  - The ureter
  - The bladder
  - The urethra
  - Sphincters
  - Prostate
3. Microscopic anatomy (4hrs)
- Nephron: Glomerular structure, tubules
  - Interstitium
  - Juxta Glomerular apparatus
4. Embryology and fetal development in brief (2hrs)
5. Anatomy of peritoneum (4hrs)
- Description
  - Size
  - Nature
  - Blood supply
  - Lymphatic drainage
6. Anatomy of Vascular system related to Hemodialysis. (6hrs)
- Upper limb vessels.  
(Course, distribution, branches, origin, and abnormalities)
  - Neck vessels.  
(Course, distribution, branches, origin, and abnormalities)
  - Femoral vessels.  
(Course, distribution, branches, origin, and abnormalities)
- II. Physiology of Kidney: (30hrs)**
1. Basic concepts (6hrs)
- Glomerular filtration



- renal auto regulation of blood supply & GFR
  - clearance
  - Tubular reabsorption
  - Aldosterone, ADH & water homeostasis
  - Tubular secretion
  - Maximal tubular transport capacity
2. Summary of major functions of Nephron & its components in urine formation. **(4hrs)**
- Glomerulus
  - PCT
  - Henley's loop (Descending limb & thick ascending limb)
  - DCT
  - Collecting duct: Cortical, Medullary.
3. Renal regulatory Mechanism **(4hrs)**
- Water regulatory mechanism
  - Electrolyte regulation (Sodium, Potassium, Chloride, Calcium, Phosphate, Magnesium)
  - Regulation of acid – base balance (basic principles & abnormalities)
4. Renal hormones & vit D, erythropoietin, Renin, Prostaglandins **(2hrs)**
5. Physiological values **(2hrs)**
- Urea, Creatinine, Electrolytes, Calcium, Phosphorus, uric acid, Magnesium, Glucose.
  - 24 hours urinary indices – urea, Creatinine, electrolytes Ca, M
6. Physiology of peritoneum during P.D **(2hrs)**
- Diffusion through the peritoneum.
- Definition
  - Factors influencing solute transport
- i) Peritoneal permeability
  - ii) Solute characteristics
  - iii) Concentration gradient
  - iv) Peritoneal blood flow
  - v) Dialysis solution temperature
  - vi) Available membrane area
7. Routes of solute transport. **(1hrs)**
- Intracellular.
  - Extracellular.
8. Factors that enhance diffusion. **(1hrs)**
- Increased dialysis solution flow.
  - Increased blood flow.
  - High concentration gradient.
  - Pre-warmed dialysis solution.
  - Osmotic pressure.
9. Osmosis through the peritoneal membrane. **(2hrs)**
- Ultrafiltration.
  - Drug transport.
10. Composition and function of blood – Introduction **(4hrs)**
- Red blood cells: Erythropoiesis, stages of differentiation function, count physiological variation.
  - Hemoglobin: structure, functions, concentration physiological variation methods of Estimation of Hb
  - White blood cells: Production, function, life span, count, differential count
  - Platelets: Origin, normal count, morphology functions.

- Plasma Proteins – Production, concentration, types, albumin, globulin, Fibrinogen, prothrombin functions.
- Hemostasis & Blood coagulation: Hemostasis: Definition, normal hemostasis, clotting factors, mechanism of clotting, disorders of clotting factors.
- Blood Bank :Blood groups –  
     ABO system, Rh system  
     Blood grouping & typing  
     Cross matching: Rh system – Rh factor, Rh in compatibility.
- Blood transfusion – Indication, universal donor and recipient concept.
- Selection criteria of a blood donor. transfusion reactions Anticoagulants – Classification, examples and uses
- Anemia's: Classification – morphological and etiological. Effects of anemia on body
- Erythrocyte sedimentation Rate (ESR) and Packed cell volume
- Blood Volume :Normal value, determination of blood volume and regulation of blood
- Volume
- Body fluid: pH, normal value, regulation and variation
- Lymph: lymphoid tissue formation, circulation, composition and function of lymph

11. Hemostasis – basic principles (2hrs)

- Coagulation cascade
- Coagulation factors
- Regulation of procoagulants & anticoagulants BT, CT, PT, PTT, thrombin time

**III. Biochemistry** (30hrs)

1. Biological oxidation oxidative reduction electron transport chain-bioenergetics system-high energy phosphate system.
2. Metabolism of carbohydrates- aerobic & anaerobic metabolic metabolism of glucose-Role of liver in carbohydrate metabolism-alternate aerobic pathway-Role of carbohydrate metabolism-Alternate aerobic pathway-pentose-muscle contraction-regulation of blood sugar-metabolism of other hexoses.
3. Lipid metabolism-Introduction-Blood lipids-absorption-oxidation of fatty acids-synthesis-energetic of fat metabolism-metabolism of cholesterol.
4. Proteinmetabolism-Absorption-storage-general pathway-nitrogen metabolism-anabolism-catabolism-Metabolism of amino acids
5. Water & Mineral Metabolism-Sodium – potassium- chloride-Sulphur-calcium-phosphorus-magnesium-Ion Iodine copper-Zinc etc.
6. Classification, mechanism of action of hormones regulating hormones calcium and phosphorus.
7. Regulation of pH of Blood and body fluids: Regulatory mechanisms, Renal Mechanism, Disturbances in acid-base balance, respiratory acidosis , respiratory alkalosis, metabolic acidosis, metabolic alkalosis, assessment of the acid- base balance, carbon-di-oxide combining power of blood, alkali reserve, anion gap, Evaluation of Acid –Base balance

8. Renal function Formation and composition of urine – Specific gravity and pH, solids and 24 hour urine, abnormal constituents of urine- Glycosuria - glycosuria, fructosuria, pentosuria, lactosuria, galactosuria. Proteinuria, Ketone bodies, Bile pigments and bile salts, Blood, porphyrins, Urinary lithiasis.
9. Function & Test of Liver.
10. Over view of estimation of serum creatinine, blood urea, serum electrolytes, 24 hrs. Urinary protein – Lab methods.

#### **IV. Nephro pathology:**

**(30hrs)**

1. Renal histology.
2. Renal pathology
  - Glomerular diseases
  - Tubulo interstitial nephritis
  - Chronic renal failure
3. Allograft pathology
4. Hypertension and other vascular diseases
5. Hemogram
6. Peripheral blood smear
7. Urine analysis
  - Urine collection
  - Physical characteristics (Color, smell)
  - Specific gravity and osmolality
  - pH
  - Glucose
  - Ketones
  - Electrolytes
  - Protein & related substances
  - Sediments – cells, crystals, casts

#### **V. Nephro-immunology**

**(20hrs)**

Nature of the Immune system

1. Historical concepts and introduction to serological testing:
  - a. Immunity and immunization
    - Cellular verses humoral immunity
    - Antigens and haptens
    - Cells – mediated immunity
  - b. The Age of serology
  - c. Other historical developments
2. Natural Immunity:
  - a. External defense system
  - b. Internal defense system
    - cellular Defense mechanism
    - acute phase reactants
    - inflammation
  - c. Summary
3. The lymphoid system:

- a. Primary lymphoid organs
  - Bone marrow
  - Bursa of fabricius
  - Thymus
- b. Secondary lymphoid organ
  - Spleen
  - Lymph nodes
  - Other secondary organs
- c. Surface marker on lymphocytes
- d. Stages in B-cell differentiation
  - Pro- B cells
  - Pre – B cells
  - Immature B cells
  - Mature B cells
  - Activated B cells
  - Plasma cells
- e. T cells Differentiation
  - Double – negative stage
  - Double positive stage
  - Mature T cells
  - Antigen activation
- f. Third population or natural killer
  - Mechanism of cyto toxicity
  - Antibody – Dependent cell
- g. Laboratory identification of lymphocytes
  - Fluorescence Microscopy
  - Cell flow cytometry
  - Other methods
- h. Summary
- 4. Nature of Antigens and the MHC Complex
  - a. Factors influencing the immune response
  - b. Traits of Immunogens
  - c. Nature of epitopes
  - d. Haptens
  - e. Relationship of antigens to the Host
  - f. Adjuvants
  - g. Major Histocompatibility Complex
    - Genes coding for the HLA antigens
    - Class I Antigens
    - Class II antigens
    - Antigen presentation
    - MHC and Autoimmunity
- 5. Antibody structure and Function:
  - a. Tetra peptide structure of immunoglobulin
    - Cleavage with papain
    - Pepsin digestion
  - b. The Nature of Light Chains
  - c. Heavy chain sequencing
  - d. Antigen recognition unit
  - e. Hings region

- f. IgG
  - g. IgM
  - h. IgA
  - i. IgD
  - j. IgE
  - k. Theories of antibody diversity
  - l. Genes coding for immunoglobulin
  - m. Monoclonal antibody
  - n. Summary
6. Cell-Mediated Immunity:
- a. Activation of T Helper cells
    - Adhesion Molecules
    - Specific Antigen recognition
    - Function of Interleukin-2
    - Triggering of Interleukin-1
    - T- Helper subsets
  - b. Stimulation of B cells
  - c. Activation of cytotoxic T cells
    - Role of cytokines in the inflammatory response
    - I-1, I-2, I-3, I-4, I-5, I-6, Other I , Interferon's, TNF, other factors
  - d. Laboratory determination of T lymphocyte function
    - Summary
7. Complement:
- a. The classic pathway
    - The recognition unit
    - The activation unit
    - The membrane attack
  - b. The alternative pathway
  - c. System controls
    - fluid phase regulators
    - cell – bound regulators
  - d. Other cell membrane Receptors
  - e. Biologic manifestation of complement activation
  - f. Complement and Diseases states
  - g. Complement Deficiencies
    - Paroxysmal Nocturnal Hemoglobinuria
    - Other complement
      - Laboratory detection of complement abnormalities
      - summary
8. Transplantation:
- a. Review of MHC
  - b. Transplantation
    - Descriptive terms
    - Graft rejection
    - Tissue matching
    - Types of tissues and organs transplanted
    - Prevention and treatment of rejections

<b>VI. Microbiology Related To Dialysis</b>	<b>(40hrs)</b>
1. Morphology	<b>2 hours</b>
Classification of microorganisms, size, shape and structure of bacteria	
2. Bacterial growth and nutrition	<b>2 hours</b>
Nutrition, growth and multiplications of bacteria	
3. Sterilisation and Disinfection	<b>2 hours</b>
Principles and use of equipments of sterilization	
4. Immunology	<b>2 hours</b>
Immunity, Vaccines and immunization	
5. Systematic Bacteriology	<b>15 hours</b>
Morphology, cultivation, diseases caused and laboratory diagnosis ( Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, <i>C. diphtheriae</i> , Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, <i>E. coli</i> , Klebsiella, Proteus, <i>vibrio cholerae</i> , Pseudomonas & Spirochetes)	
6. Parasitology	<b>5 hours</b>
Morphology, life cycle, laboratory diagnosis of following parasites <i>E.histolytica</i> , Plasmodium, Tape worms, Intestinal nematodes	
7. Mycology	<b>3 hours</b>
Morphology, diseases caused and lab diagnosis of Candida, Cryptococcus and opportunistic fungi	
8. Virology	<b>4 hours</b>
General properties of viruses, diseases caused lab diagnosis and prevention of Hepatitis and HIV viruses	
9. Hospital infection	<b>3 hours</b>
Causative agents, transmission methods, investigation, prevention and control	
10. Biomedical waste management	<b>2 hours</b>
<b>VII. Pharmacology</b>	<b>(20hrs)</b>
1. Medications commonly used by patient with renal failure	<b>(8hrs)</b>
• Antacids and phosphate binders	
• Anti anemic drugs	
• Anticoagulants	
• Antihypertensives	
• Antimicrobials	
• Antipruritis	
• Cardiovascular drugs	
• Chelating agents	
• Electrolytes	
• Laxatives and	
• Local anesthetics	
• Potassium ion exchange resin	
• Thrombolytic agents	
• Vitamins	
2. Pharmacology related to Renal disease, Hemodialysis and Peritoneal dialysis	<b>(12hrs)</b>
• Pharmaco kinetic and Pharmaco Dynamic principles	
• IV fluid therapy with special emphasis in renal disease.	
• Diuretics–Classification, actions, dosage, side effects & contraindications	

- Antihypertensive–Classification, action, dosage, side effects & contraindications, special reference during dialysis, vasopressors
- Drugs used in hypotension.
- Drugs & Dialysis–Dose & duration of administration of drugs
- Dialysable drugs–Phenobarbitone, Lithium, Methanol etc
- Vit D & its analogues, phosphate binders, iron, folic acid & other vitamins of therapeutic value
- Erythropoietin in detail.
- Heparin including low molecular weight heparin
- Protamine sulphate.
- Gluteraldehyde, sodium hypochlorite, hydrogen peroxide role as disinfectants & adverse effects of residual particles applicable to gluteraldehyde
- Haemodialysis concentrates – composition & dilution (Acetate & bicarbonates)
- PD fluid in particular hypertonic solutions composition (Dextrose, icodextrin solutions)
- Potassium exchange resins with special emphasis on mode of administration.

**Paper II: Clinical Nephrology (100hrs)**

**I. Kidney disease (60 hrs)**

Basic concepts related to renal failure (2hrs)

Classification of renal disease –Acute Kidney Injury, Chronic Kidney Disease (Diagnosis, Precaution, Management) (2hrs)

**A. Acute Kidney Injury (10hrs)**

Classification

- Pre renal uremia (Etiology, pathophysiology, assessment, management)
- Intra-renal uremia (Etiology, pathophysiology, assessment, management)
- Post renal uremia (Etiology, pathophysiology, assessment, management)

Clinical course o AKI

- Initiating stage
- Oliguric stage
- Diuretic stage
- Recovery stage

**B. Chronic Kidney Disease (26hrs)**

1. (Includes causes, signs and symptoms, treatment)

- Developmental/congenital disorder
- Cystic disorder
- Tubular disorder
- Neoplasms
- Infectious disease
- Glomerulonephritis
- Obstructive disorders

2. Renal problem and systemic disease

- Diabetes mellitus (DM)
- Diabetes insipidus (DI)
- Primary hyperparathyroidism
- Hepatorenal syndrome
- Gout
- Amyloidosis
- Scleroderma or progressive systemic sclerosis
- Good pasture syndrome

- SLE (Systemic lupus Erythromatosis)
- HUS
- Nephrotic syndrome
- Hypertensive nephropathy

C. Renal problem in pregnancy

D. Stages of renal dysfunction (2hrs)

Stages	Creatinine clearance (ml/min/1.73m <sup>2</sup> )	Metabolic consequences
I. Stage Normal	>90	---
II. Stage Early Renal insufficiency	60-89	Increased serum PTH
III. C.K.D	30-59	Increased calcium absorption Anemia
IV. Pre-end stage failure	15-29	Increased TD, PO <sub>4</sub> , K <sup>+</sup> acidosis
V. ESRD	<15	Uremic

E. Complications of chronic renal failure

- Anemia
- Polyneuritis
- Pericarditis
- Renal osteodystrophy
- Uremic carbohydrate intolerance
- Gynecomastia
- Infection
- Prurites

**Approach to Patient with Renal Failure** (10hrs)

F. Manifestations of renal failure:

- Systemic consequence of renal failure Alterations in following including signs, symptoms etiology & management.
- Uremia
- Fluid balance
- Electrolyte and ion balance (sodium, potassium, calcium, phosphate, Magnesium, hydrogen, bicarbonate, aluminium)
- Acid – base balance (Metabolic acidosis)
- Cardiovascular system (Hyperkalemia, Hypertension, Pericarditis, Pericardial effusion, Pericardial tamponade)
- Respiratory system
- Gastrointestinal system
- Hematological system (Anemia, Platelet dysfunction)
- Endocrine function
- Neuromuscular function & sleep problems
- Skeletal system
- Psycho-social function
- Dermatological manifestations

G. Patient history

H. Physical assessment of the renal system

I. Blood analysis

- Plasma Creatinine
- Blood urea nitrogen
- Plasma electrolytes
- Erythropoietin



- Plasma Renin
- Plasma substances (Antibodies & component with immunologic renal disorders like C3/C4 ANA)

#### J. Clearance tests

- Creatinine clearance test, urea clearance.

#### K. Treatment

(5hrs)

##### 3 basic stages

- a) Pressure reduction in remaining nephrons
- b) Conservative treatment of uremic syndrome
- c) Dialysis and transplantation

##### Indications of dialysis in AKI

##### Indications of dialysis in CKD

#### L. Contraindications for Dialysis (Including PD)

(3hrs)

- Alzheimer's Disease
- Multi-infract denaturation
- Hepatorenal syndrome
- Advanced cirrhosis with encephalopathy
- Advanced malignancy etc

## II. Renal transplantation

(40hrs)

### 1. History and statistics

- Historical events
- Statistics
- Data sources of renal replacement therapies

### 2. Immunological aspects

- Functions of the immune system
- Innate system
- Acquired (lymphoid) immune system
- Major histocompatibility complex

### 3. Evaluation of Potential Kidney transplant recipient & Donor

### 4. Storage & transplant of Kidneys

### 5. Pre/ Peri/Post-operative issues

### 6. Complications of renal transplant

### 7. Long term concerns

### 8. Commonly prescribed medications

### 9. Diagnosis of acute rejection

### 10. Other causes of sudden loss of renal function

### 11. The case with good initial renal function

### 12. The case with poor initial function

### 13. Uncontrollable rejection

### 14. Transplants in diabetes

### 15. Long term follow up

### 16. Late complications

### 17. Long term prognosis

**Paper III: Basic Principles and overview of Types of Renal Replacement Therapy (HD & PD) (130hrs)**

**I. Renal Replacement Therapy (30hrs)**

**1. Indications (10hrs)**

Most common cited clinical indications are

- Fluid overload
- Severe hypertension
- Hyperkalemia
- Metabolic acidosis
- Uremia

**2. Indications for starting dialysis (10hrs)**

- Oliguria (urine output < 200ml/12hr)
- Anurial/extreme oliguria
- Hyperkalemia ([K] >6.5mEq/l)
- Severe acidemia (pH<7.1)
- Azotemia ([urea] > 30mg/dl)
- Clinically significant organ (especially pulmonary) edema
- Uremic encephalopathy
- Uremic pericarditis
- Uremic neuropathy/myopathy
- Severe dysnatremia ([Na] <115 or > 160 meg/L)
- Hyperthermia
- Drug overdose with dialyzable toxin

**3. Management of renal failure patients: (10hrs)**

- Nutritional management in Renal failure (CKD, HD, CAPD, TRANSPLANT) (protein, calories, malnutrition).
- Anemia management in renal failure
- Medication for renal failure
- Investigation for renal failure
- Renal failure in children and pregnancy and its management

**II. Concepts and principles of HD & PD and its application to patient care. (100hrs)**

**A. History & Types of Dialysis (2hrs)**

- Hemodialysis
- Peritoneal dialysis
- Hemofiltration

**Principles of Dialysis (2hrs)**

- Reviewed basic knowledge

**Basic Concepts Related To Dialysis (6hrs)**

**1. Basic chemistry concepts (3hrs)**

**A. Review**

- an atom & atomic weight
- Molecules & molecular weight
- Mole
- Ions
- Density

- B. Basic chemistry of Dialysate
  - Blood electrolytes Vs dialysate composition
  - Mixing ratios
  - Dilution factors
  - Concentrate composition
  - Concentrate alteration
  - Bicarbonate precipitation
- 2. Dialysis related Physics (1hrs)**
  - Fluid Dynamics
  - Thermodynamics
  - Temperature measurement
- 3. Dialysis & Electronics (1hrs)**
  - Electricity
  - Conductivity
  - Electrical leakage
  - isolation transformer
  - Electronic components- (Resistors, capacitors, Diodes, thermostats, transistors, integrated circuits, voltage regulators, microprocessors, memory, resistors color code)
- 4. Scientific terms used in Dialysis (1hrs)**
  - Solution
  - Semipermeable membranes
  - Diffusion (factors effecting diffusion)
  - Filtration and ultrafiltration
  - Fluid dynamics
- B. Concepts and Principles of Hemodialysis (90hrs)**
  - 1. Applying scientific principles to dialysis (3hrs)**
    - Fluid dynamics in dialysate (Diffusion in dialysis)
    - Ultrafiltration in dialysis
    - Osmosis in dialysis
    - convection in dialysis
  - 2. Applying dialysis principles to the dialysis prescription (3hrs)**
    - Dialyser, blood flow, rate, Dialysate flow rate, dialysis time, dialysate composition, anticoagulation
  - 3. Dialysis and normal kidney (A comparison) (2hrs)**
  - 4. Hemodialysis Apparatus (4hrs)**
    - A. Dialysers
      - a. Functions & Components
        - Membranes
        - Membrane materials
        - Membrane manufacturing process
        - Membrane characteristics
        - Membrane permeability, Description.
      - b. Dialyser characteristics
        - Biocompatibility
        - Surface area
        - Molecular weight cutoff
        - UF coefficient
        - Clearance
        - Diffusion

- Connection
  - Adsorption
  - c. Dialyser categories
    - Convectonal dialyser
    - High efficiency dialyser
    - High Flux dialyser
  - d. Dialyser types depending on their design and their comparative studies. (Hollow fibre, coiled, parallel plate)
  - e. Measuring Dialyser efficiency
    - Determining Dialyser clearance
 
$$k = \frac{C_{Bi} - C_{Bo}}{C_{Bi}} \times Q_b$$
    - Determining UF rate --- Kuf
- B. Dialysate  
 Purpose  
 Composition of dialysate  
 Sodium, Potassium, Magnesium, calcium, chloride, Glucose, Bicarbonate, Acetate  
 Dialysate delivery system.
- i. Proportioning system
  - ii. Monitoring system
- Conductivity, Temperature, flow rate, Dialysate pressure, TMP blood leak detection, pH.

**5. Water treatment Plant (6hrs)**

- A. Purpose
  - Preventing harm to Pt
  - Preventing harm to equipments
- B. How water become impure?
- C. Types of contaminants and effects on Pts
  - Micro – organisms
  - Solid impurities
  - Chemical impurities
- D. Components of water treatment plant & their arrangement (Feed water components, R.O process)
- E. Monitoring water treatment plant
  - Continuous
  - Periodic monitoring
  - Microbiological testing
  - Chemical monitoring (Chloramines, Na+, K+)
  - Patient monitoring  
(Routine blood chemistries, Monitoring Pt. Symptoms)
- F. Disinfection.

**6. Dialysis Machine (5hrs)**

- Types
  - Function
- Dialysate circuit  
 Blood circuit Delivery and monitoring      Delivery and monitoring  
 Alarm function
- Equipment Dysfunction

- Maintenance & repair

## 7. Vascular access

(15hrs)

- Historic forms of vascular access
  - External A.V shunt
  - Single needle devices
  - Button devices
- Development of vascular access surgery
- Patient assessment and planning for vascular access surgery
- Anaesthesia for surgery of vascular access
- Surgical anatomy for HD access

Physiology of types of vascular access and clinical consideration

- Physiology of Arteriovenous fistula, Arteriovenous graft, Tunnelled Hemodialysis catheters
- Temporary type (IJC, S.C, F.C)
- Semi permanent
- Permanent Type

a) Types of catheter

b) Choice of device

c) Catheter placement

d) Placement techniques

e) Cut down techniques

- External jugular vein
- Internal jugular vein
- Femoral vein

f) Placement under radiographic guidance

- Ultrasound Complications
- Infectious complications
- Mechanical complications
- Thrombotic complications

## Acute complications of central venous catheter

Thoracic

- Pneumothoracic
- Tension thoracic
- Subcutaneous emphysema

Hemothorax

- Hemomediastinum
- Hydro mediastinum
- Tracheal perforation

Arterial

- Subcutaneous hematoma
- Arterial laceration
- Arteriovenous fistula
- Pseudo aneurysm

Venous

- Venous laceration

- Air embolism
- Catheter embolism

#### Lymphatic

- Thoracic duct laceration

#### Cardiac

- Right ventricular interaction
- Arrhythmia
- Perforation and tamponade

#### Neurologic

- Brachial plexus
- Stellate ganglion
- Phrenic nerve
- Vagus nerve
- Recurrent laryngeal nerve

#### Catheter misplacement

#### Late complications

- Catheter obstruction

#### Thoracic

- Hydrothorax
- Hydro mediastinum

#### Venous

- Air embolism
- Central vein thrombosis
- Superior venacava syndrome
- Hepatic vein thrombosis

#### Cardiac

- Arrhythmia
- Perforation and tamponade
- Coronary sinus thrombosis

#### Lymphatic

- Lymphatic fistula
- Chylothorax

#### Septic

- Catheter sepsis
- Septic thrombosis
- Suppurative thrombophlebitis
- Catheter performance and care
- Expected performances
- Complication , Prevention, Treatment
- Assessment and intervention for A.V.F maturation
- Non surgical methods for salvaging failed dialysis access
- Revisional surgery for failed access
- Nursing care for patient with dialysis access.
- New synthetic grafts and early access
- Biological properties of venous access devices.
- Complication of vascular access
- Infection in vascular access procedures
- Access in the neonatal and pediatric patients
- Improving vascular access outcomes

Continuous quality improvement (CQI) Clinical practice guidelines

**8. Dialysis prescription**

**(5hrs)**

Duration, Dialysate, UF, Heparin, Investigation, Medication usually given during HD in the following cases,

- For acute renal failures
- For chronic renal failure
- First HD
- Regular HD
- HD & Surgery
- HD for transplant recipients
- HD for poisoning case
- Phlasmaphersis

**9. Anticoagulation**

**(7hrs)**

a. Purpose

b. Anticoagulant requirement depending on

- Patient Characteristics
- Medical characteristics (Fever, infection, uremic etc)
- Dialyzer system characteristics
- Drug characteristics

c. Administration of Heparin during dialysis

d. Methodology

- Continuous
- Intermittent (Periodic)
- low dose (tight)
- Systemic
- Regional
- Baseline
- Controlled

e. Anticoagulation tests

- Whole blood clotting time
- Whole blood activated clotting time
- Whole blood partial thromboplastin time

f. Principles of anticoagulation

g. Heparinisation based on Pt's wt

h. Complications of Heparin therapy

i. Inadequate heparinisation

j. Heparin free dialysis

k. Other anticoagulants

l. Regional citrate anticoagulation

- Advantage
- Disadvantage

**10. Adequacy of Dialysis**

**(10hrs)**

- Urea reduction ration (URR)
- Urea kinetic Modelling (UKM)
- K t/v

Factors affecting dialysis treatment

- Clearance factor

- Time factor
- Blood flow
- Dialysate flow & type
- Dialysis
- Vascular access
- Patient

Dialyser (reprocessing)

- History
- Purpose
- Safety
- Advantage
- Disadvantage
- Steps
- Methods of reprocess
- Disinfectants
- Fiber bundle volume
- Fiber integrity test

Concepts & Principles of Peritoneal Dialysis

**(20hrs)**

A. PD Apparatus

- PD Catheter access
- Solution

B. Pt. selection

C. P.D Process

D. Modalities

E. Prescription

F. Type of PD

G. Adequacy of PD

Dialysis in Special Situations

**(12hrs)**

- Pt's with congestive cardiac failure
- Advanced liver disease
- Pts positive for HIV, HCV, HBSAg
- Failed transplant
- Poisoning cases
- Pregnancy
- Dialysis infants & children and care of pediatric patients.
- ICU cases and patient care.

Special Dialysis Procedure

**(5hrs)**

- Continuous Therapies in HD
- Haemodiafiltration
- Haemoperfusion
- SLED
- MARS
- Plasmapheresis

**(3hrs)**



## **Paper IV: Epidemiology & Biostatics**

**(60 hours)**

### **Unit 1: Introduction:**

Introduction to bio statistics and research methodology, types of variables and scales of measurements, measures of central tendency and dispersion, Skewness and Kurtosis rate, ratio, proportion, Incidence and prevalence.

**(4hrs)**

### **Unit 2: Sampling:**

Random and non-random sampling, various methods of sampling —simple random, stratified, systematic, cluster and multistage. Sampling and non-sampling errors and methods of minimizing these errors.

**(4hrs)**

### **Unit 3: Basic probability distributions and sampling distributions:**

Concept of probability and probability distribution. Normal, Poisson and Binomial distributions, parameters and application. Concept of sampling distributions. Standard error and confidence intervals.

**(6hrs)**

### **Unit 4: Tests of significance:**

- Basics of testing of hypothesis — Null and alternate hypothesis, type I and type II errors, level of significance and power of the test, p value.
- Tests of significance (parametric)- t — test (paired and unpaired), Chi square test and test of proportion, one way analysis of variance. Repeated measures analysis of variance.
- Tests of significance (non-parametric)-Mann-Whitney u test, Wilcoxon test, Kruskal-Wallis analysis of variance. Friedmann's analysis of variance. **(10hrs)**

### **Unit 5: Correlation and regression:**

Simple correlation — Pearson's and Spearman's; testing the significance of correlation coefficient linear and multiple regression. **(4hrs)**

### **Unit 6: Sample size determination:**

General concept, sample size for estimating mean and proportion, testing of difference in means and proportions of two groups **(4hrs)**

### **Unit 7: Study designs:**

- Descriptive epidemiological methods — case series analysis and prevalence studies.
- Analytical epidemiological methods — case control and cohort studies.
- Clinical trials/intervention studies, Odds ratio and relative risk, stratified analysis.

**(10hrs)**

### **Unit 8: Multivariate analysis:**

Concept of multivariate analysis, introduction to logistic regression and survival Analysis **(6hrs)**

### **Unit 9: Reliability and validity evaluation of diagnostic tests.**

Cronbach's alpha and test – retest methods **(4hrs)**

### **Unit 10: Format of scientific documents.**

Structure of research protocol, structure of thesis/research report, formats of reporting in scientific journals. Systematic review and meta-analysis. **(8hrs)**

## SECOND YEAR - THEORY

### **Paper V: Recent advances HD Procedures & Complications in renal disease patient Dialysis patients & Renal disease patients Dialysis patients & Renal Nutrition (220hrs)**

#### **1. Advanced HD procedures (30hrs)**

1. Nocturnal Dialysis
2. Online dialysis
3. Daily dialysis
4. Telemedicine in Dialysis Practice
5. Paediatric Dialysis

#### **2. Complications of renal disease patients, dialysis patients and Dialysis equipments. (110hrs)**

Clinical considerations in the Evaluation of Dialysis Patients

- a. Hypertension in Dialysis Patients
- b. Left Ventricular Dysfunction in Dialysis Subjects
- c. Coronary Artery Disease in End-Stage Renal Disease
- d. Autonomic Function and hemodynamic stability in End- Stage Renal Disease Patients
- e. Infection and immunity in End-stage Renal Disease
- f. B2-Microglobulin- Associated Amyloidosis of End-Stage Renal Disease
- g. Renal Osteodystrophy
- h. Dyslipidemias of End-Stage Renal Disease
- i. Selection of Therapy for Patients with End-stage Renal Disease
- j. Malnutrition and Intradialytic Parenteral Nutrition in ESRD Subjects
- k. Disorders of Hemostasis in Dialysis Patients
- l. Treatment of Anemia in Dialysis Subjects
- m. Acquired Cystic Kidney Disease
- n. Geriatric Dialysis Patients
- o. Diabetic Dialysis Patients
- p. Hemodialysis and Hemoperfusion for poisoning
- q. Dialysis considerations in the patient with Acute Renal Failure
- r. Infections in patients on Continuous Ambulatory Peritoneal Dialysis
- s. Balancing outcomes in Dialysis with Economic Realities

#### **3. Recent Advance in Dialysis and Nephrology (10hrs)**

#### **4. Cyber Nephrology (10hrs)**

#### **5. Calculators (20hrs)**

- IV rate and dose
- Access recirculation
- URR
- Concentration
- GFR Adult/Pedi
- Kt/V (different formulas)
- Access recirculation
- Urea volume distribution
- Creatinine Clearance
- BMI
- Weight and measures (Length, volume, weight , Fahrenheit, Celsius etc)

## 6. Renal Nutrition

(40hrs)

(30hrs)

### Part I: Nutrition

1. Energy (Calories)
2. Protein
3. Lipid (Fats& Cholesterol)
4. Carbohydrates
5. Thiamine vitamin B1, aneurine
6. Riboflavin
7. Vitamin B6 (pyridoxine, adermin)
8. Nicotinic acid (Niacin, nicotinamide)
9. Folic acid (folate, folacin, pteroylglutamic acid)
10. Vitamin b12 (cobalamin)
11. Pantothenic acid(filtrate factor)
12. Choline, biotin
13. Ascorbic acid (vitamin C)
14. Vitamin A
15. Vitamin D
16. Vitamin E
17. Vitamin K
18. Bioflavonoid (vitamin P)
19. Sodium
20. Potassium
22. Iron
23. Calcium
24. Phosphate
25. Magnesium
26. Manganese
27. Iodine
28. Copper
29. Cobalt
30. Chloride
31. Fluoride
32. trace elements
33. Dietary Fibers
34. Water

### Part II: Foods

1. Wheat
2. Rice
3. Pulses
4. Soya beans
5. Maize
6. Millets
7. Milk
8. Egg
9. Meats
10. Nuts & Dried Fruits
11. Sweet foods & sweetening agents
12. Fish
13. Vegetables
14. Fruits
15. Spices
16. Beverage

17. Alcohol

Part III: (A) Menu Planning (B) Dietary modifications

Part IV: Clinical dietetics

1. Diet Prescription
2. Peptic ulcer
3. Flatulence
4. Constipation
5. Diarrhea & dysentery
6. Protein- Energy malnutrition
7. Anemic
8. Under weight
9. Obesity
10. Diabetes mellitus
11. Kidney disease
12. Renal failure
13. Kidney stones
14. Coronary Heart Diseases and atherosclerosis
15. High BP
16. Congestive cardiac failure
17. Tube feeding

Part V: Principles of Nutritional Assessment

1. Introduction
  - a. Nutritional assessment system
  - b. Methods used in nutritional assessment
  - c. The design of nutritional assessment system
  - d. Evaluation of nutritional assessment indices
    - Reference distribution
    - Reference limits
    - Cutoff points
2. Food consumption of Individual
  - a. Methods
  - b. New development in measuring food consumption
  - c. Selecting an appropriate method
  - d. Summary
3. Evaluation of nutrient intake data
  - a. Tables of recommended nutrient intakes
  - b. Evaluating Nutrient intakes of individuals
  - c. Evaluating the nutrient intakes of population groups
  - d. Probability approach to evaluating nutrient intakes
4. Anthropometric assessment
  - a. Advantages and limitations of anthropometric assessment
  - b. Sources of error in nutritional anthropometry
  - c. Evaluation of anthropometric indices
5. Anthropometric assessment of growth
  - a. Growth measurement
  - b. Indices derived from growth measurements

VI: Bed side rounds & practices

**(10 hrs)**

## **Paper VI: Basics of Hospital Administration and Management of Dialysis Unit & Biomedical Instrumentation Biotechnology & Molecular Biology (140hrs)**

### **1. Patient education & health patient with rrt**

**(30hrs)**

- Patient Education
- Communication
- Patient communication problems
- Explanation of examinations
- Interacting with terminally ill patient
- Informed Consent
- Patient counselling on
  - Living with CKD
  - Life with HD and CAPD
  - Living with a transplanted kidney.

### **2. Basics of Management of health care organization include administrative aspects of dialysis unit**

#### **A. Hospital Structure**

**(10hrs)**

##### Basics of

- Intensive care units
- Hospital administration
- Resource management (personnel, material & finance)
- Quality management & infection control systems

#### **B. Management of Healthcare Organizations**

**(40hrs)**

##### Management functions

- Planning
- MBO
- Decision making
- Organizing
- Staffing
- Controlling

##### Management and Economics

- Demand & Supply
- Nature of Costs
- Marginal cost and breakeven analysis
- Market structure: Business & Government
- Role of Government

##### Organizational Behavior

- Significance
- Structure & theories
- Individual & group behavior
- Leadership
- Motivation
- Organizational development
- Managing creativity and stress

##### Accounting for Hospital Management

- Budgeting & Budgetary control
- Difference between forecast & budgeting\_ Preparation of budget

- Classification of budget
- Capital Budgeting

#### Concept of Hospital

- Departmentation in Hospital
- Clinical services management
- Organizing of support services
- Management of utility services
- Evaluation of Hospital services
- Issues related to Healthcare technology
- Present trend in healthcare technology
- Problems & constraints
- Planning & adopting appropriate technology in healthcare
- Evaluation method of health technology

#### Evolution of Quality management

- Quality assurance methods
- Patient satisfaction
- Standard operating procedure
- Quality certification
- Accreditation to national agencies

### **3. Biomedical Instrumentation**

**(20hrs)**

1. Introduction to Biomedical Instrumentation
  - a. The Age of Biomedical Engineering
  - b. Development of BM instrumentation
  - c. Biometrics
  - d. Introduction to the man-instrument system
  - e. Components of the man-instrument system
  - f. physiological systems of the body
  - g. Problems encountered in measuring a living system.
2. Basic Transducer principles:
  - a. The transducer and transduction principles
  - b. Active transducers
  - c. Passive transducers
  - d. Transducers for Biomedical applications
3. Sources of Bioelectric potentials:
  - a. Resting and action potentials
  - b. Propagation of Action potentials
  - c. The Bioelectric potentials
4. Electrodes
  - a. Electrode theory
  - b. Biopotential electrodes
  - c. Biochemical transducers
5. The computer in Biomedical Instrumentation:
  - a. The digital computer - Computer Hardware, Computer software
  - b. Microprocessors - Types of microprocessors, Microprocessors in Biomedical Instrumentation- Calibration , Table lookup , Averaging , Formatting and printout
  - c. Interfacing the computer and medical instrumentation and other equipment.- Digital interfacing requirement , Analog-to-digital and Digital-to-Analog conversion
  - d. Biomedical computer application - Data acquisition, storage and retrieval, data reduction and transformation, mathematical operation, pattern recognition, limit detection, statistical analysis of data, data presentation ,control function - Computer

analysis of the ECG, the digital computer in the clinical chemistry laboratory, digital computerized in hemodialysis machine, other computer application

6. Electrical safety of Medical Equipment.
    - a. Physiological effects of electrical current.
    - b. Shock hazards from electrical equipment.
    - c. Methods of accident prevention
      - Grounding
      - Double insulation
      - Protection by low voltage
      - Ground – fault circuit interrupter
      - Isolation of patient – connected parts
      - Isolated power distribution systems
  7. Patient care and monitoring:
    - a. The elements of intensive – care monitoring
      - Patient monitoring displays
    - b. Diagnosis, calibration and repairability of patient – monitoring equipment
    - c. Other instrumentation for monitoring patients
    - d. The organization of the hospital for patient care monitoring
    - e. Defibrillator
  8. Description of Machine self test
  9. Technical safety checks and maintenance
    - a. General notes
    - b. Technical safety checks and maintenance procedures
    - c. maintenance checklist
  10. Adjustment
    - a. Overview of the Dip switches
    - b. Calibration mode
    - c. Hydraulics
    - d. Dir detector
  11. Calibration Program
  12. Diagnostics Program
    - a. General notes
  13. Setup Menu
    - a. Overview
    - b. Main menu
  14. Circuit diagram and circuit description
    - a. Block diagram
    - b. level detector control (LD)
    - g. BLD
    - h. Mother board
    - i. CPU
    - j. Input / output board
    - k. Display board
    - l. Power supply
    - m. Hep - Module
4. **Molecular biology and biotechnology** (40hrs)
1. Introduction to molecular Biology
  2. Concept
  3. Basic principles of Biotechnology
  4. Molecular Biology
    - Identification of the genetic materials

- Chemical nature of genetic materials
  - Replication of DNA
  - Non-genetic ribonucleic Acid (RNA) and transcription
  - Genetic code
  - Protein synthesis
  - Regulation of gene action
5. Recombinant DNA technology
- Biology & classification of Cloning strategies & Vectors.
  - Introduction of genes into the cell
  - DNA modifying enzymes and DNA synthesis
  - Genetic Recombination and Gene Transfer (Bacterial Conjugation, Transformation, Transduction, Episomes and Plasmids)
  - Genetic Engineering (Isolation, sequencing, Synthesis of Gene and DNA Fingerprinting)
  - Site Directed Mutagenesis.
  - Antisense Technology
  - Gene therapy
6. Immunology
- Antibody antigen reaction,
  - Hybridoma technology
  - Vaccines production (Principles)
7. Stem cell research: principles and application

**Paper VII: Emergency Medicine /ACL Nephro-Radiological Nuclear Medicine  
and imaging sciences and Nephrophysiatric (60hrs)**

**1. Emergency medicine/ACLS /renal nutrition (20hrs)**

**A. BLS (10hrs)**

1. BLS in perspective
  - a. The need for Medical interventions
  - b. The ultimate Coronary Care Unit
  - c. Emergency Cardiac Care
  - d. The chain of Survival
  - e. Role of the American Heart Association
2. Cardio Pulmonary Function and actions for survival
  - a. The Cardiovascular and Respiratory system
  - b. Action for survival
3. Risk factors and prudent Heart living
  - a. Risk factors for Heart Attack
  - b. Prudent Heart Living
  - c. Summary: The role of Prevention
4. Adult BLS
  - a. Citizen response to Cardio-pulmonary Emergency
  - b. Indication for BLS
  - c. The sequence of BLS; Assessment, EMS activations and the ABC of CPR
  - d. CPR performed by one rescuer and two rescuers
  - e. Foreign – Body airway obstruction Management
  - f. CPR: The Human Dimension
  - g. BLS Research Initiative



5. Special Resuscitation Situation
  - a. Stroke
  - b. Hypothermia
  - c. Near – Drowning
  - d. Cardiac arrest associated with Trauma
  - e. Electric shock and lightning stroke
  - f. Pregnancy
  - g. Asphyseration
  - h. Special techniques and pitfalls and complication
  - i. Unique situation
6. Pediatric BLS
  - a. Epidemiology
  - b. Injury prevention
  - c. Prehospital care
  - d. The sequence of Pediatric BLS - the ABC of CPR
  - e. Activation of the EMS system obstructive
  - f. Foreign Body airway
  - g. BLS in Trauma
7. Ethical and Legal considerations
  - a. Values in Decision Making
  - b. Instituting and Discontinuing CPR
  - c. Legal mandates
  - d. Conclusions
8. Safety during CPR Training and actual rescue
  - a. Disease transmission during CPR Training
  - b. Disease transmission during actual performance of CPR
9. Automated External Defibrillation
  - a. Importance of Automated External Defibrillation
  - b. Overview of Automated External Defibrillation
  - c. Advantage and Disadvantage of Automated External Defibrillation
  - d. Use of Automated External Defibrillation during Resuscitation attempts
  - e. Automated External Defibrillation treatment algorithm
  - f. Post resuscitation care
  - g. Training
  - h. Maintenance of Skills
  - i. Medical control
  - j. Quality assurance

## **B. ACLS**

**(10hrs)**

1. Cardiopulmonary Resuscitation and Advanced Cardiac Life Support
  - a. Basic Life Support
  - b. General Considerations of Advanced Cardiac Life Support: Arrhythmia recognition and defibrillation-ventilation and airway management-route of drug administration-IV fluids-diagnose and correct the underlying cause of the arrest-internal cardiac compression-initiation and discontinuation of resuscitation.
  - c. Specific Arrest Sequences in Advanced Cardiac Life Support : VF and Pulseless VT – Systole-Bradycardia-Pulseless electrical activity(PEA)-Tachycardias
  - d. Post resuscitation Management
  - e. Common Medications Used in Advanced Cardiac Life Support : Epinephrine-Atropine sulfate-Lidocaine-Procaïnamide hydrochloride-Bretyliumtosylate-magnesium sulfate-adenosine-Diltiazem or verapamil-Isoproterenol-Sodium bicarbonate-Calcium

## 2. Critical Care

- a. Respiratory Failure: General considerations-pathophysiology-Blood gas analysis
- b. Oxygen therapy: Nasal prongs-venturi masks-Nonrebreathing masks-A continuous positive airway pressure mask-Bilevel positive airway pressure
- c. Airway Management and Tracheal Intubation: Airway Management-Endotracheal intubation-Surgical airways
- d. Mechanical Ventilation: Indications-Initiation of mechanical ventilation-Management of problems and complications-Weaning from mechanical ventilation-Drugs commonly used during endotracheal intubation and mechanical ventilation
- e. Shock: Resuscitative Principles-Individual shock states
- f. Hemodynamic Monitoring and Pulmonary Artery Catheterization: Indications-obtaining a pulmonary capillary wedge tracing-acceptance of PAOP readings-transmural pressure-Cardiac output-Interpretation of hemodynamic readings

## 3. Cardiac Arrhythmias

- a. Recognition and Management: Clinical diagnosis of arrhythmias-Electrocardiographic data-Bradycardias-premature complexes-Tachycardia-
- b. Antiarrhythmic Drug Therapy: General Principles-Antiarrhythmic agents
- c. Related Topics: Syncope-Electro-cardioversion-Cardiac pacing-Anti-tachycardia devices

## 2. Nephro-radiological and imaging sciences and nuclear medicine (20hrs)

### 3. Radiological and Imaging Sciences (15hrs)

1. Ultrasound Sonographic imaging characteristics
2. Doppler ultrasound – scanning techniques (ultrasound of the normal kidney – acute renal failure – surgical – medical renal disease – renal masses – cysts- solid renal masses – calculi – intrarenal hematomas – renal transplant evaluation – rejection – renal infections) Doppler ultrasound in evaluation of renal vascular disease and Transplant kidney evaluation.
3. Computed Tomography Of The Kidney: Anatomy – renal masses – cystic masses – solid renal masses – tumors of the renal pelvis – renal calculi – obstructive uropathy – infarction – acute renal cortical necrosis – renal vein thrombosis – renal artery stenosis – acute pyelonephritis – renal and perinephric abscess – emphysematous pyelonephritis – pyelonephrosis – xanthogranulomatous pyelonephritis – tuberculous pyelonephritis – congenital anomalies – renal trauma – transplant kidneys
4. Urography: intravenous urography – indications – contra indications – interpretation.
5. Magnetic Resonance Imaging: normal kidney – congenital anomalies – obstruction – injection – renal parenchymal disease– hypertension and renal vascular disease – renal cysts – benign neoplasm's – malignancies of kidney.
6. Renal Angiography: Indications – relative contraindications.
7. Renal Biopsy

### 4. Nuclear Medicine (5hrs)

1. Basic of nuclear medicine.
2. DTPA, DMSA.
3. Peritoneal scintigraphy.
4. Reflex scintigraphy.
5. Transplant renal scintigraphy.

## 5. Nephropsychiatry

(20hrs)

1. Psychiatric Assessment
  - a. Introduction to clinical assessment
  - b. The Psychiatric interview
  - c. The mental status Exam
  - d. Physical Exam and laboratory evaluation
  - e. Intelligence testing and neuropsychological assessment
  - f. Personality assessment
2. Psychiatric Aspects of Renal Care
  - a. Introduction
  - b. Psychiatric problems: uncooperativeness-cause of uncooperativeness
  - c. Depression and Suicide, anxiety, rehabilitation problems, sexual problems
  - d. Psychiatric fitness for Transplantation
  - e. Treatment of psychiatric problems-preventive therapy-group therapies-environmental Manipulations-psychotherapy-pharmacotherapy-behavioral sexual techniques
3. Rehabilitation and Psychosocial Issues
  - a. Endurance Exercise training in hemodialysis patients
  - b. Psychosocial rehabilitation of Adult dialysis patients
  - c. Ethical Dilemmas in Dialysis: To initiate or withdraw Therapy
4. Mental Disorders
  - a. Diagnosis and classification in psychiatry
  - b. Psychiatry history and examination
  - c. Organic( Including Symptomatic) mental disorders
  - d. Psychoactive substance use disorders
  - e. Schizophrenia
  - f. Mood Disorders, Anxiety and personality
  - g. Other psychotic Disorders
  - h. Neurotic, stress-related and somatoform disorders
  - i. Disorders of Adult personality and behaviour
  - j. Sexual disorders
  - l. Sleep disorders
  - m. Behavioural syndromes associated with psychological disturbances and physiological factors
  - n. Mental retardation
  - o. Child psychiatry
  - p. Psychopharmacology
  - q. Biological methods of treatment
  - r. Psychoanalysis
  - s. Psycho treatment
  - t. Emergency psychiatry
  - u. Legal and ethical issues in psychiatry
  - v. Common psychiatry

## PRACTICALS

(2100hrs)

(400hrs)

### **1. Patient Care**

#### **A. Assessment**

Collect & evaluate patient data

- Access Patency
- Apical pulse
- Blood pressure
- Breath sound
- Heart Sound
- Jugular vein distension
- Peripheral edema
- Pulse
- Respiration
- Signs of infection
- Temperature
- Weight
- Communication with patient

#### **B. Pre dialysis procedures**

a. Following HD orders and treatment plan

b. Equipment preparation procedures

- Preparing dialysate according
- Assembling the extracorporeal circuit
- Priming the dialyser & extracorporeal circuit
- Pre – initiation check

#### **C. Initiation of Dialysis**

a. Fluid removal procedures

- Calculating amount of fluid to be removed
- Predicting UF
- Calculating TMP
- Calculating UF rate
- Fluid replacement
- Isolated ultra filtration

b. Venipuncture procedure

- Needle insertion in a fistula or graft
- Initiating dialysis treatment
- Clean & dress access site (venous cannulation) using appropriate technique

c. Monitoring during dialysis

- Patient monitoring procedures
  - Taking vital signs
  - Monitoring general patient condition
  - Providing comfort and diversion during dialysis
- Technical monitoring
  - Monitoring devices
  - Equipment safety checks
  - Extracorporeal circuit
- Blood pump settings
- Adjust arterial & venous pressures

- Adjust fluid removal
- Monitor the dialysate delivery system
- Heparinisation during dialysis
- Recognize complications occurring during dialysis & their management
  - Chills
  - Cramps
  - Fever
  - Shock
- Recognize and management of complication due to operator & equipment error
  - Air embolism
  - Bleach or formaldehyde reaction
  - Chemical pyrogen reaction
  - Hemolysis and water quality
- Recognize problem regarding heparinisation (Coagulation, hemorrhage, hemostasis)
- Recognize access complication in patients (Clotting, infection, recirculation)
- Recognize blood leaks
- Recognize complication with administration of medication (Antihypertensive, Erythropoietin, iron dextran).

#### D. Post Dialysis Procedures

- Completing dialysis treatment procedures
- Discontinuing dialysis
- Post dialysis pt. check
- Taking vital signs and weight
- Documentation
- Equipment clearing / disinfection

#### E. Medications, solutions and laboratory test

##### a. Medications and solution procedures

- drawing solution
- Using I.V solutions

##### b. Laboratory tests procedures

- Drawing blood specimen
- Blood sampling pre & post dialysis (Bun measurements)
- Monitoring of anemia
- determining R.B.S
- Determining Kt/V, recirculation, URR, Aluminum level, blood chemistry, culture, hematocrits, hepatitis study, iron study.
- Perform coagulation studies to determine Heparinisation

##### c. Documenting patient care

- Treatment record

## 2. Hemodialysis Catheterization Under Guidance

(100hrs)

- Types of catheter
- Choice of device
- Catheter placement
- Placement techniques
- Cut down techniques
- External jugular vein
- Internal jugular vein
- Femoral vein
- Placement under radiographic guidance
- Ultrasound

### **3. Machine Technology**

**(400hrs)**

Maintenance of system:

- Clean & disinfect dialysis equipments as per unit policy (Protocol)
- Develop preventive maintenance schedules for all dialysis equipment and maintain record
- Document all dialysis equipment repair work performed
- Maintain emergency equipment in proper working condition for immediate use
- Maintain / verify the calibration of HD machines
- Order supplies & equipment for dialysis unit perform repairs to equipment
- Perform electrical leakage tests for all dialysis equipments
- Verify blood & dialysate flow rate.

Machine set up:

A. Assemble dialysis equipment for operation

B. Perform residual chemical checks

C. Perform required safety checks

- Conductivity
- pH
- Pressure holding test
- Temperature

D. Perform safety checks

- ABD (Air Bubble Detector)
- Arterial pressure gauge
- Blood leak alarm
- Blood pump
- Dialysis fluid
- Heparin pump
- Venous pressure gauge
- Dialysis check

E. Prepare bicarb solution

F. Prepare dialysis machine

- Rinse
- Prime
- Caliberate alarm
- Set monitor
- Fluid delivery system
- Connection

G. Perform Disinfection procedure of dialysis machine

### **4. Water Treatment Plant**

**(250hrs)**

A. Continuous monitoring

- Temperature, pressure, flow rate, conductivity resistivity, total dissolved solids (TDS)

B. Periodic monitoring

- Softener regeneration
- Hardness test
- total chlorine, chloramines test
- chemical analysis
- pH
- Others

Microbiological tests

- Disinfection
- Culture
- Record maintenance

Dialyser processing	(30hrs)
<ul style="list-style-type: none"> <li>- Process dialyser according to protocol</li> <li>- Maintain processing record</li> <li>- Perform reuse test <ul style="list-style-type: none"> <li>• Bacterial culture</li> <li>• Presence of disinfectant</li> <li>• Pressure testing</li> <li>• Visual inspection</li> </ul> </li> </ul>	
Electronics	(30hrs)
<ul style="list-style-type: none"> <li>- Components</li> <li>- Relationship – voltage, amperage, resistance</li> <li>- Basic multimeter skills</li> <li>- Concepts <ul style="list-style-type: none"> <li>• Transformer</li> <li>• Relays</li> </ul> </li> <li>- Reading wiring diagram / schematics</li> <li>- Electrical safety</li> <li>- Handling P.C boards</li> <li>- Soldering skills</li> </ul>	
Computers	(20hrs)
<ul style="list-style-type: none"> <li>- Cabling</li> <li>- Operating system</li> <li>- Computer components</li> </ul>	
Plumbing	(20hrs)
<ul style="list-style-type: none"> <li>• Fittings</li> <li>• Sizes</li> <li>• Materials</li> </ul>	
Management of dialysis unit	(50hrs)
Special and advanced dialysis procedures	(100hrs)
Peritoneal dialysis	(90hrs)
Cpr demo	(10hrs)
Teaching methodology	(600hrs)
Distribution of marks for the first year	

## **Subsidiary Subject**

### **Ethics - 10 Hrs**

**(Should be taught to the 1st year students)**

**Introduction:** With the advances in science and technology and the increasing needs of the patient, their families and community, there is a concern for the health of the community as a whole. There is a shift to greater accountability to the society. It is therefore absolutely necessary for each and every one involved in the health care delivery to prepare them to deal with these problems. Other professionals are confronted with many ethical problems.

Standards of professional conduct are necessary in the public interest to ensure an efficient laboratory service. Every sinologists or sonographer should not only be willingly to play his part in

giving such a service, but should also avoid any act or omission which would prejudice the giving of the services or impair confidence, in respect, for sinologists or sonographer as a body.

To accomplish this and develop human values, it is desired that all the students undergo ethical sensitization by lectures or discussion on ethical issues.

### **Introduction to ethics-**

What is ethics?

General introduction to Code of Laboratory Ethics

How to form a value system in one's personal and professional life?

International code of ethics

### **Professional Ethics-**

Code of conduct

Confidentiality

Fair trade practice

Handling of prescription

Mal practice and Negligence

Professional vigilance

### **Research Ethics-**

Animal and experimental research/ humanness Human experimentation

Human volunteer research - informed consent Clinical trials

Gathering all scientific factors

Gathering all value factors

Identifying areas of value – conflict, setting priorities

Working out criteria towards decision

ICMR/ CPCSEA/ INSA Guidelines for human / animal experimentation

### **Suggested Readings :**

1. Human Anatomy - B.D. Chaurasia
2. Gray's Anatomy for the students – Richard L. Drake
3. Human Physiology - A.K. Jain
4. Anatomy and physiology in health and illness – Ross and Willson
5. Text Book of Pathology - Harsh Mohan
6. Basic Pathology – pocket Robbins
7. Medical Pharmacology – Padmaja Uday Kumar
8. KD Tripathi – Essentials of Medical Pharmacology
9. The Kidney – By Barry Brenner, Floyd
10. Clinical Dialysis, Dialysis Therapy- By Nissenson, Fine
11. Complications of dialysis- By Norbert Lemeire, Ravindra Mehta
12. Dialysis technology- By Jim Curtis , Philip Varughese
13. Hand book of dialysis – By Daugirdas, Peter Gerard Blake
14. Renal Nursing – By Nicola Thomas
15. Review of HD – By C.F. Butch, Martha H Stoner, Anna L. Corea



16. Some are from internet sources.
17. Lwanga SK and Cho-YookTye (Editors). Teaching Health Statistics, Twenty lessons and seminar outlines, World Health Organization, Geneva.
18. Mahajan BK. Methods in Biostatistics for medical students and research workers. 6th Edition, Jaypee Brothers Medical Publishers, New Delhi, 1997.
19. Kothari CR. Research Methodology: Methods and Techniques. Wiley Eastern Ltd, New Delhi.
20. Sundar Rao P55 and Richard J. Introduction to Biostatistics: A Manual for Students in Health Sciences. Prentic-Hall of India Pvt. Ltd, New Delhi.
21. Park E. Park's Text book of Preventive and Social Medicine, M/S Banarasidas Bhanot, Jabalpur.
22. Nair S K. Essential Research Methodology, Epidemiology and Biostatistics. In: ShobhaTandon, editor. Text Book of Pedodontics, 2~ ed. Hyderabad: Paras Publishing; 2001 p 687-96.
23. Armitage P, Berry G. Statistical methods in medical research, 3rd ed. London: Blackwell Scientific Publications; 1994.
24. Daniel W W. Biostatistics: A foundation for analysis in health sciences, 2nd ed. New York; John Wiley and Sons, 1987.
25. Principles of Management by Koonz 'o' Donnel
26. Hospital planning Administration by B.M. Shakar

**19. MODEL QUESTION PAPER**  
(Common for both specialities – 1<sup>st</sup> & 2<sup>nd</sup> year)

**THEORY**

Each theory paper will have

- |  |                |
|--|----------------|
| 1) Essay questions – 03 nos. carrying 10 marks each        | - 03 x 10 = 30 |
| 2) Short answer questions – 10 nos. carrying 05 marks each | - 10 x 05 = 50 |

Total	= 80
Internal assessment	= 20

**PRACTICAL**

- |                        |   |      |
|------------------------|---|------|
| (a) Preliminary:       |   |      |
| Internal assessment    | : | 15   |
| University examination | : | 60   |
| Total                  |   | = 75 |
| (b) Viva               |   | = 25 |

