

**CENTRAL UNIVERSITY OF HARYANA**

**Master of Science in Nutrition Biology**

**Semester I**

S.No.	Course code	Course title	L	T	P	Credit
1.	SIAL NB_01_1_01_CC	Human Physiology	5	0	0	5
2.	SIAL NB_01_1_02_CC	Nutritional Biochemistry I	5	0	0	5
3.	SIAL NB_01_1_03_CC	Human Nutritional Requirements	5	0	0	5
4.	SIAL NB_01_1_04_CC	Practical I: Nutritional Biochemistry and Nutrient Requirements	0	0	10	5
5.	GE	<i>To be taken from other department</i>	4	0	0	4

**Generic Elective Course (GEC) offered by the department to students of other departments**

S.No.	Course code	Course title	L	T	P	Credit
<i>Offered in Semester I</i>						
1.	SIAL NB_01_1_01_GEC	Human Nutritional Requirements	4	0	0	4
2.	SIAL NB_01_1_02_GEC	Nutrient Deficiencies and Assessment	4	0	0	4

**Semester II**

1.	SIAL NB_01_2_05_CC	Nutritional Biochemistry II	4	0	0	4
2.	SIAL NB_01_2_06_CC	Biostatistics and Research Methods	4	0	0	4
3.	SIAL NB_01_2_07_CC	Food Microbiology and Food Safety	4	0	0	4
4.	SIAL NB_01_2_08_CC	Practical II: Microbiology and Nutrient Analysis	0	0	10	5
5.	SIAL NB_01_2_03_GEC	Bioinformatics (compulsory)	0	3	0	3
6.	NB DCEC	<i>Any one of the following three courses</i>	5	0	0	5
	SIAL NB_01_2_01_DCEC	Nutrition & Immunity				
	SIAL NB_01_2_02_DCEC	Nutraceuticals & Functional Foods				
	SIAL NB_01_2_03_DCEC	Nutritional Toxicology				

**Semester III**

1.	SIAL NB_01_3_09_CC	Nutrient Deficiencies and Assessment	4	0	0	4
2.	SIAL NB_01_3_10_CC	Nutrition in Chronic Degenerative Diseases	4	0	0	4
3.	SIAL NB_01_3_11_CC	Practical III: Clinical & Biochemical Evaluation in Deficiencies & Diseases	0	0	8	4

4.	SIAL NB_01_3_04_DCE C	Seminar Paper (compulsory)	0	2	0	2
5.	GE	<i>To be taken from other department</i>	4	0	0	4
6.	DCEC	<i>Any one of the following three courses</i>	5	0	0	5
	SIAL NB_01_3_05_DCE C	Work Physiology, Physical Fitness & Health				
	SIAL NB_01_3_06_DCE C	Nutrigenomics & Transgenic Crops				

**Generic Elective Course (GEC) offered by the department to students of other departments**

<i>Offered in Semester III</i>						
3.	SIAL NB_01_3_04_GEC	Nutrition in Chronic Degenerative Diseases	4	0	0	4
4.	SIAL NB_01_3_05_GEC	Work Physiology, Physical Fitness & Health	4	0	0	4
5.	SIAL NB_01_3_06_GEC	Food Microbiology and Food Safety	4	0	0	4

#### **Semester IV**

**Skill Enhancement Elective Course (Compulsory and exclusively for Nutrition Biology students)**

S.No.	Course code	Course title	L	T	D	Credit
1.	SIAL NB_01_4_01 SEEC	Dissertation	0	0	24	24

**CORE COURSES**  
**SIAL NB\_01\_1\_01\_CC: HUMAN PHYSIOLOGY**  
**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to:

1. Understand all aspects of general and systemic physiology.
2. Describe physiological mechanisms of the human body
3. Comprehend the patho-physiological processes of diseases

**UNIT I: General and Cellular Physiology**

**4**

- Cell as the living unit of the body
- Homeostasis and Control systems
- Transport across cell membranes
- Functional systems in the cells

**UNIT II: Hematology**

**10**

- Erythropoiesis
- Destruction and fate of RBCs
- Classification and functions of each type of WBC
- Blood Groups and Blood typing
- Principles of transfusion medicine
- Anemias, Polycythemia, Leucopenia, Leukemias, Thalassemia

**UNIT III: Renal Physiology and Fluid balance**

**10**

- Body fluid compartments
- Water balance- regulation of fluid balance
- Urine formation
- Regulation of extracellular sodium and osmolarity
- Renal mechanisms for the control of blood volume, blood pressure and ionic composition and regulation of acid-base balance
- Micturition, Diuretics, Renal failure and Kidney function tests

**UNIT IV: Cardio-vascular Physiology****16**

- Properties of cardiac muscle and specialized tissues
- Cardiac cycle, Cardiac output, Blood pressure (factors & regulation)
- Cardiac failure, Atherosclerosis, Ischemia, Myocardial Infarction, Hypertension

**UNIT V: Gastro-intestinal Physiology****8**

- General principles of GI function
- Digestion and absorption
- Pathophysiology of peptic ulcer and diarrheal disease

**UNIT VI: Endocrine and Reproduction Physiology****12**

- Classification of hormones and mechanism of hormone action
- Endocrine function of the hypothalamus, Pituitary, Thyroid, Adrenals, Endocrine pancreas, Pathophysiology of diabetes
- Parathyroid, calcitonin, Vitamin D and calcium metabolism
- Male sex hormones, Spermatogenesis, Hyper and hypogonadism
- Menstrual cycle, Female sex hormones, Contraceptives, Pregnancy and lactation

**RECOMMENDED READINGS**

- Fox SI.( 2006) Human Physiology. 9th Edition. McGraw-Hill.
- Guyton and Hall.( 2006) Text book of Medical physiology.11th Edition. W B Saunders and Company.
- Gerard J. Tortora and Sandra R. Grabowski. .( 2006) Principles of Anatomy and Physiology, control systems of human body, Vol-3, 10th edition, Wiley and Sons.
- K.E. Barrett, S.M. Barman, S. Boitans and H. Brook (2009). Ganong's Review of Medical Physiology, 23rd Edition (Lange basic science), Tata McGraw.

**SIAL NB\_01\_1\_02\_CC: NUTRITIONAL BIOCHEMISTRY I**  
**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to:

1. Explain how the body utilizes energy and maintains energy balance.
2. Describe the mechanism of action and regulation of enzymes.
3. Understand the properties and role of macronutrients.
4. Discuss the inter-relationship between carbohydrates, proteins and fats.

**UNIT I: Biological Energy**

**6**

- Energy value of foods, measurement of energy content of food.
- Thermogenesis, energy utilization by cells
- Energy balance - BMR, physical activity
- Mechanism of control- hunger, appetite

**UNIT II: Enzymes**

**10**

- Mechanism of action of enzymes and co-enzymes involved in biological oxidation and reduction, enzyme inhibition
- Respiratory chain,
- Role and mechanism of phosphorylation in biologic oxidation and energy capture

**UNIT III: Carbohydrates**

**12**

- Basic Structures and Nomenclature
- Sources, functions , properties
- Reducing Sugars – Chemical and Biochemical Significance.
- Digestion and absorption
- Glycolysis, Glycogenolysis, Gluconeogenesis, TCA cycle, HMP shunt, bioenergetics,
- Hormonal Regulation of Carbohydrate Metabolism, Diabetes

**UNIT IV: Lipids****14**

- Structure and functions, Classification and properties of lipids, essential fatty acids
- Digestion and absorption, utilization and storage,
- Effects of deficiency and excess of fat
- Fatty acid oxidation and biosynthesis
- Cholesterol: Properties, Biosynthesis, Functions, Lipoproteins Structure, Properties and their significance.

**UNIT V: Amino acids and Proteins****14**

- Types and structure of amino acids, properties, nutritional classification of amino acids
- Amino acid balance, imbalance and toxicity, amino acid pool.
- Protein – Introduction to general properties, structure, sources, functions, digestion, absorption, utilization and storage, denaturation, protein quality evaluation. Nitrogen metabolism, urea cycle

**UNIT VI: Inter Relationship Between Carbohydrate, Fat And Protein****4****RECOMMENDED READINGS**

- Nelson, D.L. and Cox, M.M.( 2005) Lehninger Principles of Biochemistry, W.H. Freeman & Com.
- Victor W. Rodwell. (2015)Harpers Illustrated Biochemistry 30th Edition. Lange.
- Devlin D.T. (2010)Text book of Biochemistry with Clinical Correlations. 7<sup>th</sup> edition. New York, John Wiley and Sons.

**SIAL NB\_01\_1\_03\_CC: HUMAN NUTRITIONAL REQUIREMENTS**  
**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to:

1. Critically evaluate the methodology and derivation of requirements of nutrients.
2. Understand how the nutritional considerations change with age and physiological group.
3. Appreciate the effect of malnutrition on growth and cognitive development.
4. Understand how nutrient requirements change in special conditions.
5. Learn various measures for improving the quality of diets.

**UNIT I: Human Nutrient Requirements**

**30**

- Historical perspective of nutrient requirements and definitions (Recommended Nutrient Intakes, Minimum requirements, Subsistence requirements, Dietary reference intakes, Optimum nutrient intake)
- Methods of assessment of nutrient needs (factorial approach, balance studies, nutrient turnover, isotope studies, depletion-repletion studies, obligatory loss, enzyme studies)– a critical review
- Critical evaluation of sensitive methods and derivations of requirements, factors affecting the requirements, recommended dietary allowances of macronutrients for all age groups:
  - Energy
  - Carbohydrates and dietary fibre
  - Proteins and amino acids
  - Lipids and fatty acids
  - Water soluble vitamins
  - Fat soluble vitamins
  - Minerals and trace elements
  - Water



- Food Pyramid, Dietary guidelines for Indians, Guidelines for physical activity (national and international)

**UNIT II: Growth and Development through Lifecycle** **15**

- Aspects of growth- cellular to physical
- Determinants of growth and development in children
- Nutritional considerations for adults, pregnant & lactating mothers, infants, preschoolers, school-age children, adolescents, elderly.
- Impact of altered nutrition on growth and development
- Maternal malnutrition and pregnancy outcome
- Malnutrition and cognitive development
- Body composition changes through the lifecycle and its consequences

**UNIT III: Nutrition in Special Conditions** **5**

Physiological changes and altered nutritional requirements in

- Extreme temperatures - low and high
- High altitude
- Space nutrition and food systems
- Sports nutrition

**UNIT IV: Improving Nutritional Quality of Diets** **10**

- Ongoing nutrition transition and its implications.
- Ways of improving nutritional quality of diets.
- Assessment of protein quality.
- Dietary diversification.
- Bioavailability of nutrients.
- Nutrient losses during cooking and processing.
- Emerging concepts in human nutrition-Nutrigenomics, nutraceuticals, functional foods and bioactive compounds.

## RECOMMENDED READING

- Chadha R and Mathur P.( 2015) Nutrition: A Lifecycle Approach. Orient Blackswan, New Delhi.
- ICMR (2010). Nutrient Requirements and Recommended Dietary Allowances for Indians. National Institute of Nutrition, Hyderabad.
- FAO/WHO/UNU (2004). Human Energy Requirements. Report of a Joint Expert Consultation.
- WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.
- FAO/WHO (2004). Vitamin and Mineral Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation.
- Bamji M.S., Rao N.P., Reddy V. Eds. (2009). Textbook of Human Nutrition. 3<sup>rd</sup> Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
- NFI (2006).Nutrition in Developmental Transition. NFI-WHO (SEARO) Symposium.
- Shils M.E., Shike M, Ross A.C., Caballero B and Cousins RJ. (2005) Modern Nutrition in Health and Disease.10<sup>th</sup> ed.Lipincott, William and Wilkins.
- Mahan LK and Escott- Stump S. (2008) Krause's Food and Nutrition Therapy. 12<sup>th</sup> ed. WB Saunders-Elsevier. USA.
- ILSI (2006). Present Knowledge in Nutrition. Ed. Bowman B A and Russel R M. 9<sup>th</sup> edition. ILSI Press, Washington, DC

**SIAL NB\_01\_1\_04\_CC: NUTRITIONAL BIOCHEMISTRY & NUTRIENT REQUIREMENT  
(CREDITS: PRACTICAL-5)**

**PRACTICAL**

**10 periods/week**

1. Qualitative analysis - Reaction of pentoses, hexoses, dextrin, starch, glycogen.
2. Estimation of fat by Soxhlet method and cold method
3. Estimation of Total protein by Microkjeldhal / Macrokjeldhal method
4. Extraction of lipids from egg yolk
5. Estimation of Serum proteins by Biuret method
6. Estimation of Creatinine in urine - Jaffe's method.
7. Estimation of Serum cholesterol - Zak's method.
8. Estimation of Blood glucose – GOD-POD method.
9. Measurement of energy expenditure using indirect calorimetry/heart rate measurements
10. Assessment of protein quality of dishes and meals by various indices- NDpCal%, PDCAAS
11. Identification of food sources which are rich in Energy, Proteins, Fat, Calcium, Iron, Vitamin A, Thiamine, Riboflavin, Niacin, Vitamin C.
11. Field visits to institutions conducting research in human nutrition and report writing of the visits
12. Demonstration of instruments used in analytical work- NMR, HPLC, GLC, Atomic Absorption Spectrophotometer, Mass Spectrometer for nutrient analysis.

**RECOMMENDED READING**

- FAO/WHO/UNU. (2004) Human Energy Requirements. Report of a Joint Expert Consultation.
- Gopalan C et al (1990). Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
- WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.

- ICMR. (2010) Nutrient Requirements and Recommended Dietary Allowances for Indians. National Institute of Nutrition, Hyderabad.
- Raghuramulu N, Nair M.K. and Kalyansundaram S (eds) (2003). A manual of laboratory techniques. 2<sup>nd</sup> edition. National Institute of Nutrition, ICMR.
- Sundararaj P and Siddhu A. (2002) Qualitative Tests and Quantitative Procedures in Biochemistry : A Practical Manual. Phoenix Publishers, Revised Edition.

## Semester II

### SIAL NB\_01\_2\_05\_CC: NUTRITIONAL BIOCHEMISTRY II

(CREDITS: THEORY-4)

#### THEORY

LECTURES: 60

#### Objectives:

The student will be able to:

1. Describe the mechanism of maintaining fluid and electrolyte balance
2. Discuss the role of various vitamins and minerals in the body
3. Understand the mechanism of action of hormones in the body

#### UNIT I: Electrolytes

8

- Electrolyte content of fluid compartments
- Functions of electrolyte- Sodium, Potassium and Chloride
- Absorption, Transport and balance
- Factors affective electrolyte balance and hydrogen ion balance.

#### UNITII: Fat Soluble Vitamins

10

Vitamins A,D,E, K –

- Chemistry, Functions, Physiological action
- Digestion, Absorption, Utilization, Transport, Storage, Excretion,
- Sources, Deficiency, Diagnosis of deficiency

#### UNIT III: Water Soluble Vitamins

12

Thiamine, Riboflavin, Niacin, Folic acid, Pyridoxine, Cyanocobalamin, Pantothenic acid, Biotin, Ascorbic acid –

- Chemistry, Functions, Physiological action
- Digestion, Absorption, Utilization, Transport, Storage, Excretion
- Sources, Deficiency, Diagnosis of deficiency

#### UNITIV: Minerals

10

Calcium, phosphorus, iron –

- Distribution in the body
- Digestion, Absorption, Utilization, Transport, Excretion, Factors affecting absorption
- Balance, Deficiency, Toxicity, Sources
- Regulation of serum calcium concentration, Calcium: Phosphorus ratio

#### **UNIT V: Trace Elements**

**6**

Iodine, Fluoride, Zinc, Selenium, Manganese, Chromium-

- Distribution in the human body
- Physiological function, deficiency, Toxicity and Sources.

#### **UNIT VI: Hormones**

**14**

- Overview of endocrine glands, hormones as chemical messengers, stimulus for hormone release: change in homeostasis , sensory stimulus and others.
- Structures, Receptor type
- Regulation of biosynthesis and release (including feed back mechanism).
- Physiological and Biochemical actions

#### **RECOMMENDED READING**

- Nelson, D.L. and Cox, M.M.( 2005). Lehninger Principles of Biochemistry, W.H. Freeman & Com
- Victor W. Rodwell. (2015)Harpers Illustrated Biochemistry 30th Edition. Lange.
- Devlin D.T. (2010)Text book of Biochemistry with Clinical Correlations. 7<sup>th</sup> edition. New York, John Wiley and Sons.
- Plummer D.T. (1997). An Introduction to Practical Biochemistry. New Delhi, Tata McGraw Hill Publishing Company.
- Widmaier, E.P.,Raff, H. and Strang, K.T.(2008).Vander,Sherman,Luciano's Human Physiology, McGraw- Hill Higher Education.
- Darnell, J.,Lodish, H. and Baltimore, D.(2008). Molecular Cell Biology, Scientific American Books.
- Eccles R. (1993). Electrolytes , Body fluids and Acid Base balance, London, Edward Arnold - A division of Hodder and Stoughton

**SIAL NB\_01\_2\_06\_CC: BIOSTATISTICS AND RESEARCH METHODS**  
**(CREDITS: THEORY-4)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to:

1. Understand basic statistical procedures and purpose for research
2. Comprehend the varied approaches to research and format of a research design and process
3. Apply statistical techniques for analysis and interpretation
4. Use selective software for qualitative and quantitative data analysis
5. Write research proposals

**UNIT I: Introduction to statistics**

**8**

- Basic principles and concepts in statistics
- Fundamentals of measurement- quantity and quality
- Scales of measurement: Nominal, ordinal, interval and ratio
- Reliability, validity and standardisation of measurement
- Types of sampling

**UNIT II: Organization and presentation of data**

**8**

- Data reduction strategies
- Coding and tabulation, Grouping of data, Frequency distributions
- Graphic representation: Graphs, diagrams and charts
- Descriptive statistics and its applications
- Characteristics of distributions: Normal curve, Skewness, kurtosis
- Percentage, percentile ranking and frequencies

**UNIT III: Statistical Tests**

**20**

- Testing hypotheses: Levels of significance and estimation
- Z scores, calculation and application
- Parametric tests of difference: T test, ANOVA and post hoc analysis
- Parametric tests of association: Pearson's product moment  $r$
- Non-parametric tests of difference: Mann-Whitney, Sign, Median, and KruskalWallis

- Non-parametric tests of association: Spearman's • Chi-square test
- Regression and prediction

**UNIT IV – Computer Applications** **6**

Using software to perform the statistical tests – EXCEL, SPSS, Atlas.ti

**UNIT V: Methods of Research** **18**

- Types of research designs
- Quantitative and qualitative research tools- questionnaires, interview schedules, focus group discussions, observation checklist
- Defining the research area- developing research questions, the approach
- Reading, reviewing and referencing studies, journals, books and papers
- Writing a research proposal- developing the objectives, methods of study, analyses, budget according to format of funding agencies like ICMR/UGC/DBT/CSIR
- Social responsibility and ethics in research

**RECOMMENDED READINGS**

- Bell, J. (1999). *Doing Your Research Project: Guide for First Time Researchers in Social Sciences*. New Delhi: Viva Books.
- Blaxter, L. Hughes, C. and Tight, K. (1999). *How to Research*. New Delhi: Viva Books.
- Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA: Sage Publications.
- Minium, E. W., King, B. M., & Bear, G. (1995/2004). *Statistical Reasoning for Psychology and Education*. New York: Wiley and Sons.
- Muijs, D. (2004). *Doing Quantitative Research in Education with SPSS*. London: Sage.
- Mahendra, N.P., Gogtay, N. (2009). *ABC of Research Methodology and Applied Biostatistics—A Primer for Clinicians and Researchers*.
- Hilla B., Christa V.W., Gisela V.R. (2006) *Fundamentals of Research Methodology for Health Care Professionals* Juta and Company Ltd.



**SIAL NB\_01\_2\_07\_CC: FOOD MICROBIOLOGY AND FOOD SAFETY  
(CREDITS: THEORY-4)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to-

- To study the important genera of microorganisms associated with food and their characteristics.
- To learn the role of microorganisms in food spoilage, food fermentation and food borne diseases.
- To understand the concept of food preservation by conventional and recent methods.
- To study microbiological quality control in food safety and hygiene.
- To familiarise with food safety regulations and food safety management tools.

**UNIT I: Microorganisms Associated with Food and its Spoilage**

**14**

- Sources of contamination in foods
- Important types of food spoilage bacteria and fungi
- Factors affecting the growth of microorganisms in food (temperature, pH, water activity, redox potential, oxygen availability, relative humidity and presence of antimicrobial substances).
- Spoilage of some specific food groups (milk, egg, meat, fruits and vegetables and their juices, canned foods)

**UNIT II: Food Fermentation**

**8**

- Definition of fermentation and types of fermentations
- Microorganisms involved in food fermentations
- Advantages of food fermentations
- Types of fermented foods and microorganisms involved in production of vinegar, sauerkraut, yoghurt, soya sauce and wine
- Traditional Indian and oriental fermented foods

**UNIT III: Food borne Diseases****12**

- Food borne infections, food borne intoxications and food borne toxicoinfections- definitions with examples
- Types of bacterial and fungal toxins
- Symptoms, foods involved and prevention of some commonly occurring food borne diseases caused by *Clostridium botulinum*, *Staphylococcus aureus*, *Shigella sp.*, *E.coli*, *Salmonella*, *Bacillus cereus*, *Vibrio cholerae* and rotavirus

**UNIT IV: Enumeration and Control of Microorganisms in Food****10**

- Qualitative and quantitative methods of enumeration-(conventional and rapid methods)
- Principles and methods of preservation -use of high temperature, low temperature, drying, filtration, radiations, chemical preservatives and bio preservatives
- Hurdle Technology

**UNIT V: Principles of Hygiene and Sanitation in Food Service Establishments****6**

- Important terms and definitions- hygiene, sanitation, disinfection, sterilization
- Control methods using physical and chemical agents
- Methods of waste disposal, pest and rodent control measures, personnel hygiene and its importance

**UNIT VI: Food Safety and Food Safety Management Tools****10**

- Important terms and definitions
- Types of hazards (biological, chemical, physical hazards)
- Factors affecting Food Safety
- Microbiological quality control
- Important food safety tools- Indicator microorganisms, HACCP, ISO series, PFA, TQM and Risk analysis

**RECOMMENDED READINGS**

- Frazier, WC and Westhoff, D.C.(2004). Food Microbiology, TMH, New Delhi.
- Jay and James M, (2000). Modern Food Microbiology, CBS Publication, New Delhi.
- Garbutt, J. (1997) Essentials of Food Microbiology, Arnold, London.

- Pelczar, MJ, Chan ,ECS and Krieg, N.R.,(1993). Microbiology, 5th Ed., TMH, New Delhi
- Lawley, R, Curtis, L and Davis,J, 2004 The Food Safety Hazard Guidebook , RSC publishing.
- De Vries, (1997) Food Safety and Toxicity, CRC, New York
- Marriott, N.G.(1985) Principles of Food Sanitation, AVI, New York
- Forsythe, S.J.(1987) Microbiology of Safe Food, Blackwell Science, Oxford
- Adams ,M.R., Moss,M.O. and Peter McClure,P.(2015) Food Microbiology, 4<sup>th</sup>ed RSC Publishing
- Montville,T.J. and Matthews,K.R, (2008) Food Microbiology:An Introduction .2<sup>nd</sup>ed,ASM Press,Washington DC,USA.

## SIAL NB\_01\_2\_08\_CC: MICROBIOLOGY & NUTRIENT ANALYSIS

(CREDITS: PRACTICAL-5)

### PRACTICAL

10 periods/week

1. Ashing of food and preparation of ash solution.
2. Estimation of calcium and phosphorus in food.
3. Estimation of total carotenoids in food by column chromatography– carrot, papaya.
4. Estimation of iron in food by spectrophotometer.
5. Estimation of ascorbic acid in food by dye method.
6. Isolation of microorganisms by pure culture technique and microbial count by Standard Plate Count Method
7. Morphological characteristics of various bacteria and fungi associated with food.
8. Use of biochemical tests for identifying bacteria.
9. Detection of aflatoxin in peanuts by thin layer chromatography
10. Microbiological analysis of water, milk, fruit juices, street foods
11. Assessment of Surface sanitation by Swab and Rinse method

### RECOMMENDED READINGS

- Raghuramulu N, Nair MK and Kalyansundaram S (eds). A manual of laboratory techniques. 2<sup>nd</sup> edition. National Institute of Nutrition, ICMR. 2003
- Bell C, NeavesPandWilliams AP. Food Microbiology and Lab Practice. 2006
- Cappuccino JG and Sharman N. Lab Manual of Microbiology. Pearson Education Publishing Co. 2002.

## Semester III

### SIAL NB\_01\_3\_09\_CC: NUTRIENT DEFICIENCIES AND ASSESSMENT (CREDITS: THEORY-4)

#### THEORY

LECTURES: 60

#### Objectives:

The student will be able to:

1. Describe the deficiency signs and symptoms related to different nutrients
2. Understand the aetiology and preventive measures for the different deficiency diseases
3. Assess nutritional status using anthropometric measurements and biochemical parameters.

#### UNIT I: Introduction

15

- Relationship between nutrition, health and disease
- Macronutrients and micronutrients – functions, food sources, Recommended Dietary Allowances according to age, sex, activity, physiological condition.
- Impact of deficiency, excess or imbalanced intake of nutrients on health.

#### UNIT II: Nutritional deficiency diseases

15

Protein energy malnutrition, Nutritional anemias, Vitamin A deficiency, Iodine deficiency disorders, Vitamin D deficiency

- Etiology and pathogenesis
- Clinical manifestations and biochemical changes

#### Unit III: Public health aspects of malnutrition

14

- Treatment of deficiency diseases- hospital and community setting
- Prevention strategies- overview of National policies and programs
- Nutrition surveillance and monitoring

#### Unit IV: Methods of Assessment of Nutritional Status

16

- Types of diet surveys
- Concept of diet quality and adequacy

- Anthropometric measurements – indices and reference standards
- Biochemical parameters and clinical examination

### **RECOMMENDED READINGS**

- Chadha R and Mathur P.( 2015) Nutrition: A Lifecycle Approach. Orient Blackswan, New Delhi.
- ICMR (2010). Nutrient Requirements and Recommended Dietary Allowances for Indians. National Institute of Nutrition, Hyderabad.
- Maurice E. Shils, Moshe Shike, A. Catharine Ross and Benjamin Caballero. (2005). Modern Nutrition in Health and Disease. 10<sup>th</sup> edition. Lipincott, William and Wilkins.
- Gibson R.S. (2005). Principles of Nutritional Assessment. 2<sup>nd</sup> edition. Oxford University Press.

**SIAL NB\_01\_3\_10\_CC: NUTRITION IN CHRONIC DEGENERATIVE DISEASES**  
**(CREDITS: THEORY-4)**

**THEORY**

**LECTURES: 60**

**UNIT I: Weight Management and Diabetes Management** **18**

Etiopathophysiology, metabolic and clinical aberrations, diagnosis, complication, treatment, dietary management and recent advances in

- Obesity, overweight and underweight
- Diabetes Mellitus – Type 1, Type 2

**UNIT II: Cardiovascular Disorders** **16**

Etiopathophysiology, metabolic and clinical aberrations, diagnosis, complication, treatment, dietary management and recent advances in CVD

- Hypertension
- Hyperlipidemia
- Metabolic syndrome
- Atherosclerosis

**UNIT III: Overview of-** **18**

- Musculoskeletal and rheumatic disorder – Osteoporosis, Arthritis, SLA and Multiple Sclerosis
- Alzheimers and Parkinsons diseases
- Liver cirrhosis, fatty liver
- Celiac disease
- HIV-AIDS
- Chronic kidney disease

**UNIT IV: Cancer** **8**

- Role of diet in etiology and management
- Effect of cancer therapy on dietary status

**RECOMMENDED READINGS**

- Shils ME, Shike M, Ross A.C., Caballero B and Cousins R.J.(2005). Modern Nutrition in Health and Disease. 10<sup>th</sup> ed. Lipincott, William and Wilkins.

- L. Kathleen Mahan , Janice L Raymond , Sylvia Escott-Stump (2012). Krause's Food & the Nutrition Care Process, 13th Edition 13th Edition. Saunders Elsevier
- Michael J. Gibney , Marinos Elia, Ljungqvist O and Dowsett J. (2005). Clinical Nutrition (The Nutrition Society Textbook). Blackwell Science.



**SIAL NB\_01\_3\_11\_CC: CLINICAL AND BIOCHEMICAL EVALUATION IN  
DEFICIENCIES & DISEASES  
(CREDITS: PRACTICAL-4)**

**PRACTICAL**

**8 periods/week**

1. Nutritional anthropometry
  - Measurement of height, weight, MUAC, waist and hip circumference
  - Interpretation – use of WHO Growth Standards
  - Calculation and interpretation of BMI, waist-hip ratio
  - Handgrip strength measurement by dynamometer
2. Biochemical analysis of body fluid ( Urine & Serum and Plasma) to assess the Nutrient deficiencies/disorders using spectrophotometer/ blood analyser
  - Hemoglobin
  - Lipid profile
  - Blood urea nitrogen
  - Serum electrolytes
3. Assessment clinical signs of nutrient deficiencies
4. Evaluation of the dietary adequacy of sample diet.
5. Measurement of body composition using bioelectrical impedance
6. Measurement of bone mineral density using DXA
7. Assessment of patient needs- nutritional assessment and screening.
8. Market survey of dietetic foods.
9. Critical evaluation of food labels and claims.
10. Visit to hospitals for observation of feeding devices for patients.
11. Blood pressure measurement.

**RECOMMENDED READINGS**

- Gibson R.S. (2005). Principles of Nutritional Assessment. 2<sup>nd</sup> edition. Oxford University Press..
- Raghuramulu N, Nair MK and Kalyansundaram S. (2003) eds. A manual of laboratory techniques. 2<sup>nd</sup> edition. National Institute of Nutrition, ICMR.
- Shils ME, Shike M, Ross A.C., Caballero B and Cousins R.J.(2005). Modern Nutrition in Health and Disease. 10<sup>th</sup> ed. Lipincott, William and Wilkins.

**DISCIPLINE CENTRIC ELECTIVE COURSES (DCEC)**

**SIAL NB\_01\_2\_01\_DCEC: NUTRITION & IMMUNITY**

**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives**

The student will be able to:

1. Understand the relationship between nutrition, immunity and infection
2. Discuss the role of different nutrients in enhancing immunity
3. Appreciate the adverse effects of infection on nutritional status
4. Outline operational implications for improving health and nutritional status

**Unit I: Concept of Immunity and Health**

**15**

- Overview of the defence mechanisms of the body- cells and organs of the immune system, humoral and cellular immunity
- Assessment of the immune response
- Relation between infection , immunity and nutritional status

**Unit II: Effect of Nutritional Status on Immunity**

**20**

- Alterations in immune responses due to malnutrition
- Role of micronutrients in improving immunity
- Effect of infection on the nutritional status
- Other factors affecting immunity- ageing, obesity, stress, exercise, alcohol, phytochemicals, pre- and probiotics

**Unit III: Problems of the Immune System**

**10**

- Allergies
- Autoimmune Diseases
- Other diseases linked to immune system

**Unit IV: Operational Implications**

**15**

- Maternal& children nutrition - Infections and birth outcomes immunity & infections of infants and children, Impact of breast feeding on immunity of infants
- Immunisation
- Prevention of communicable diseases
- Relationship of Probiotics, prebiotics with immunity and nutrition

## RECOMMENDED READINGS

- M. Eric Gershwin, Penelope Nestel, Carl L. Keen – (2004) *Handbook of Nutrition and Immunity*.
- DA Hughes, LG Darlington, and A Bendich, (2004). *Diet and Human Immune Function* Humana Press, Totowa, NJ
- David C. Nieman, Bente Klarlund Pedersen . (2000) *Nutrition and Exercise Immunology*. CRC Press.
- Mohan Pammi, Jesus G. Vallejo, Steven A. Abrams – (2014) *Nutrition- Infection Interaction and Impact on Human Health* , ,CRS Press, Taylor & Frsis Group
- *Diet, Immunity and Inflammation* *Woodhead Publishing Series in Food Science, Technology and Nutrition* Woodhead Publishing Limited, 2013

**SIAL NB\_01\_2\_02\_DCEC: NUTRACEUTICAL & FUNCTIONAL FOODS**  
**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to:

1. Understand fundamental concepts and knowledge related to functional foods
2. Critically evaluate the mechanism of action and health benefits of different types of nutraceuticals
3. Examine and assess the latest developments in nutraceutical research
4. Understand national and international regulations regarding nutraceuticals

**UNIT I: Meaning & Concept**

**12**

- Definition and examples of nutraceuticals, functional foods, dietary supplements, fortified foods (scope and relevance)
- Classification of nutraceuticals
  - according to source of origin: phytonutraceuticals, animal origin, microbial, algal
  - Nutrient and non-nutrient
  - Probiotic, prebiotic and symbiotic

**UNIT II: Mechanism of Action**

**18**

- Cellular and molecular mechanisms of action of different types of nutraceuticals
- Absorption, disposition, metabolism and elimination of nutraceuticals
- Potential health benefits and applications in risk reduction of diseases
- Adverse effects and toxicity

**UNIT III: Food processing for Nutraceuticals and Functional foods**

**20**

- Extraction and isolation of nutraceuticals
- Perspective for food applications
- Recent advancements in formulation and processing of functional foods
- Nanotechnology and functional food
- Probiotics: Important features of probiotic micro-organisms, Health effects including mechanism of action, use in various foods: fermented milk products,

non-milk products etc.

- Prebiotics: Meaning, Chemical Nature, sources & mechanism of production, metabolism, Importance of Prebiotics in Functional Foods, effects on human health and potential applications in risk reduction of diseases, Perspective for food applications for the following: Non-digestible CHO / Oligosaccharides. Dietary fibre, resistant starch, gums

#### **UNIT IV: Regulatory issues and industrial scope**

**10**

- Indian regulations for nutraceuticals/functional foods
- Quality assurance of probiotics and safety, ICMR Guidelines on Probiotics
- International regulations
- Consumer acceptance –issues for the future

#### **RECOMMENDED READINGS**

- Wildman R.E.C. ed (2000) Hand book of Nutraceuticals and functional Foods, CRC. Press Boca Raton.
- Fuller R. ed (1992) Probiotics the Scientific basis London, Chapman and Hall, New York.
- Gihsm G, Williams, C-ed (2000) Functional foods, Woodhead Publishing Ltd. U.K.
- Cho S.S. and Dreher, M.L (2001) Hand book Dietary Fibre, Marul Dekker Inc., Ney York
- Cupp J & Tracy T.S. (2003). Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
- Gibson G.R & William C.M. (2000). Functional Foods - Concept to Product.
- Losso J.N. (2007). Angi-angiogenic Functional and Medicinal Foods. CRC Press.
- Manson P. (2001). Dietary Supplements. 2nd Ed. Pharmaceutical Press.
- Campbell J.E. & Summers J.L. (2004). Dietary Supplement Labeling Compliance.
- Shi J. (Ed.). (2006). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
- Frei, B. (1994) Natural anti oxidants in human health and disease. Academic

Press, San Diego

- Webb G.P. (2006). Dietary Supplements and Functional Foods. Blackwell Publ
- Tannock G.W. (1999): Probiotics: A Critical review, Horizon Scientific Press. U.K.
- Robert, E.C. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman
- Brigelius-Flohé, J & Joost H.G. (2006). Nutritional Genomics: Impact on Health and Disease. Wiley VCH.
- Neeser J.R. & German B.J. (2004). Bioprocesses and Biotechnology for Nutraceuticals.
- Chapman & Hall Goldberg I. (1994). Functional Foods: Designer Foods, Pharma Foods Disease. Wiley VCH

**SIAL NB\_01\_2\_03\_DCEC: NUTRITIONAL TOXICOLOGY**  
**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

This course will enable the students to:

1. Understand basic principles of toxicology
2. Identify and describe different sources of toxicity in the food supply
3. Discuss the potential effects of different toxicants on health
4. Describe toxic effects of nutrients eaten in excess of requirements
5. Understand the relationship between nutrient uptake and drug bioavailability.

**UNIT I: Basic Principles of Toxicology** **15**

- Introduction to basic terms in toxicology
- Overview of methods of toxicity testing (in vivo and in vitro studies)
- Concept of risk analysis, steps involved in risk assessment studies

**UNIT II: Toxicants/Hazards in Food Supply** **15**

- Physical, chemical and biological hazards- types, sources
- Potential toxic effects of different hazards
- Foodborne illness – causes, prevention

**UNIT III: Toxicity of Nutrients and Food Ingredients** **15**

- Vitamins, minerals and dietary supplements
- Naturally present toxicants in foods
- Food additives – concept of GRAS, ADI, adverse health effects of different additives, role of JECFA in assessing safety of food additives
- Food allergies and intolerances

**UNIT IV: Drug-Nutrient Interaction** **15**

- Disease states or drugs that may cause vitamin or mineral deficiency – mechanism of action
- Strategies for prevention and management

**RECOMMENDED READINGS**

- Omaye, S.T.( 2004) Food and nutritional toxicology.. CRC Press. Boca Raton,

FLA.

- Kotsonis, F.N. and M. Mackey, Eds. (2001) Nutritional toxicology, second edition.. Taylor & Francis. New York, NY.
- Shaw, I.C. (2013) Food safety: The science of keeping food safe. Wiley-Blackwell. Ames, IA.
- Püssa T. (2013) Principles of Food Toxicology, Second Edition. CRC Press. ISBN 9781466504103.
- Deshpande S.S.( 2002.) Handbook of Food Toxicology. CRC Press. ISBN 9780824707606



**SIAL NB\_01\_3\_04\_DCEC: SEMINAR PAPER (COMPULSORY)**

**(CREDITS: 2)**

**SIAL NB\_01\_3\_05\_DCEC: WORK PHYSIOLOGY, PHYSICAL FITNESS AND  
HEALTH**

**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

After completing this course the student will be able to:

1. Understand concepts & components of health and physical fitness.
2. Discuss the effect of physical activity on body composition, cardiovascular, neuroendocrine and musculo-skeletal system.
3. Describe the process of energy metabolism during exercise or physical activity.
4. Understand the importance of maintaining thermoregulation, fluid & electrolyte balance

**UNIT I: Health and physical fitness**

**16**

- Definition of health, components of health, holistic health, positive health concept
- Physical fitness- definition, components, methods of assessing, role in maintenance of healthy & wellness and types of exercises for fitness training
- Guidelines for physical activity to maintain health, prevent obesity and its co-morbidities

**UNIT II. Body composition and musculoskeletal system**

**14**

- Body composition, role in physical performance, changes with physical activity
- Muscle -structure, composition and effects of physical activity
- Skeletal system and physical activity

**UNIT III: Cardiovascular system and Energy metabolism**

**10**

- Types of energy systems, energy continuum and energy release.
- Cardiovascular response to training and measurement of anaerobic & aerobic capacity.

**UNIT IV: Thermo regulation and fluid and electrolyte balance**

**10**

- Exercise and thermo regulatory mechanism
- Fluid and electrolyte balance

**UNIT V: Improving physical performance**

**10**

- Ergogenic aids: definition, market, types and effects

- Exercise and the neuroendocrine system

### **RECOMMENDED READINGS**

- Mc Ardle WD, Katch FL and Katch VL. (1996) Exercise physiology. 4<sup>th</sup> edition. Williams and Wilkins A Waverly company
- Per-Olof Astrand , Kaare Rodahl, Hans A. Dahl , Sigmund B. Stromme. (2005) Astrand and Rodahl Exercise physiology. Textbook of Work Physiology: Physiological Bases of Exercise 4th Edition
- Hickson JH. (2000). Nutrition for Exercise and Sport. 2<sup>nd</sup> edition. CRC Press.

**SIAL NB\_01\_3\_06\_DCEC: NUTRIGENOMICS AND TRANSGENIC CROPS**  
**(CREDITS: THEORY-5)**

**THEORY**

**LECTURES: 60**

**Objectives:**

The student will be able to:

1. Understand how diet and underlying genetics interact to increase susceptibility to disease
2. Describe methods and strategies used to study complex trait genetics and nutrition
3. Discuss how nutrients and other bioactive compounds can alter gene expression for improved disease outcome or prevention.
4. Explore how genetic modification of crops can be used to more effectively deliver drugs, vaccines, nutrients and bioactive substances

**UNIT I: Introduction to nutrigenomics and epigenetics** **12**

- Definitions
- Control of gene transcription and expression
- Interaction of molecules with genes
- Bioactive food components
- Practical applications

**UNIT II: Methods to study gene-nutrient interaction** **16**

- Introduction to various target validation models (cell line testing, zebrafish model and animal models)
- Control of gene transcription and screening models

**UNIT III: Nutrition, disease and associated targeted genes** **22**

- Single nucleotide polymorphisms and associated metabolic aberrations
- Diseases which can be addressed by nutrigenomics
- Genes and gene products which are important in these diseases
- Scope of personalised nutrition

**UNIT IV: Role of transgenic crops** **10**

- Scope of genetic modification in altering nutritional properties and content of bioactive substances in food with details of ongoing research in the field
- Concept and feasibility of GM therapeutic foods for drug and phytochemical

delivery

## RECOMMENDED READINGS

- Qi L. Gene-Diet Interactions in Complex Disease: Current Findings And Relevance For Public Health, *CurrNutr Rep* 2012: 1: 222-227.
- Tucker K. L., Smith C. E., Lai C. Q., Ordovas J. M. Quantifying Diet ForNutrigenomic Studies, *Annual Review Of Nutrition* 2013: 33: 349-371.
- Peters L. L., Robledo R. F., Bult C. J., Churchill G. A., Paigen B. J., Svenson K. L. (2007). The Mouse as a Model for Human Biology: A Resource Guide For Complex Trait Analysis, *Nature Reviews Genetics*: 8: 58-69.
- Frazer K. A., Murray S. S., Schork N. J., Topol E. J. Human Genetic Variation And Its Contribution To Complex Traits, *Nature Reviews Genetics* 2009: 10: 241-251.
- David L. A., Maurice C. F., Carmody R. N., Gootenberg D. B., Button J. E., Wolfe B. E. Et Al (2013). Diet Rapidly And Reproducibly Alters The Human Gut Microbiome, *Nature*.
- Frayling T. M., Timpson N. J., Weedon M. N., Zeggini E., Freathy R. M., Lindgren C. M. Et Al (2007). A Common Variant inthe FTO Gene Is Associated With Body Mass Index And Predisposes To Childhood And Adult Obesity, *Science*: 316: 889-894.
- Zhang X., Qi Q., Zhang C., Smith S. R., Hu F. B., Sacks F. M. Et Al (2012). FTO Genotype and 2-Year Change in Body Composition and Fat Distribution In Response To Weight-Loss Diets: The Pounds Lost Trial, *Diabetes*: 61: 3005-3011.
- Tanaka T., Ngwa J. S., Van Rooij F. J., Zillikens M. C., Wojczynski M. K., Frazier-Wood A. C. Et Al (2013). Genome-Wide Meta-Analysis Of Observational Studies Shows Common Genetic Variants Associated With Macronutrient Intake, *Am J ClinNutr*: 97: 1395-1402.
- DO R., Xie C., Zhang X., Mannisto S., Harald K., Islam S. Et Al (2011). The Effect of Chromosome 9P21 Variants on Cardiovascular Disease May Be Modified By Dietary

Intake: Evidence From A Case/Control And A Prospective Study, Plos Medicine: 8: E1001106.

- Cornelis M. C., El-Soheby A., Kabagambe E. K., Campos H. Coffee, Cyp1a2 Genotype, And Risk of Myocardial Infarction, Jama 2006: 295: 1135-1141.
- Madden J., Williams C. M., Calder P. C., Lietz G., Miles E. A., Cordell H. Et Al (2011). The Impact of Common Gene Variants on the Response of Biomarkers of Cardiovascular Disease (Cvd) Risk to Increased Fish Oil Fatty Acids Intakes, Annual Review of Nutrition: 31: 203-234.
- Garcia-Calzon S., Martinez-Gonzalez M. A., Razquin C., Corella D., Salas-Salvado J., Martinez J. A. Et Al. The Pro12ala Polymorphism Of The Ppargamma2 Gene Interacts With A Mediterranean Diet To Prevent Telomere Shortening In The Predimed-Navarra Randomized Trial, CircCardiovasc Genet 2014.
- Dolinoy D. C., Weidman J. R., Waterland R. A., Jirtle R. L. (2006). Maternal Genistein Alters Coat Color And Protects Avy Mouse Offspring From Obesity By Modifying The FetalEpigenome, Environmental Health Perspectives: 114: 567-572.
- Jirtle R. L., Skinner M. K. (2007). Environmental Epigenomics and Disease Susceptibility, Nature Reviews Genetics: 8: 253-262.
- Cooney C. A., Dave A. A., Wolff G. L. Maternal Methyl Supplements In Mice Affect Epigenetic Variation And Dna Methylation of Offspring, J Nutr 2002: 132: 2393s-2400s.
- Yatkin A.L and Pool R. (2007) Nutrigenomics And Beyond. Institute Of Medicine, National Academic Press, Washington, D.C.
- Kaput, J and Rodriguez R. (Eds) (2006). Discovering the Path to Personalised Nutrition. In: Nutritional Genomics. Wiley and Sons Inc., New York.

**SKILL ENHANCEMENT ELECTIVE COURSES (SEEC)**

**SIAL NB\_01\_4\_01\_SEEC: DISSERTATION**

**(CREDITS: 24)**