

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 01 01 C 5005	Human Physiology	5	0	0	5
2.	SIAL NB 01 01 02 C 5005	Nutritional Biochemistry I	5	0	0	5
3.	SIAL NB 01 01 03 C 5005	Human Nutritional Requirements	5	0	0	5
4.	SIAL NB 01 01 04 C 00105	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 01 01 GEC 4004	Human Nutritional Requirements	4	0	0	4
2.	SIAL NB 01 01 02 GEC 4004	Nutrient Deficiencies and Assessment	4	0	0	4

Semester II

1.	SIAL NB 01 02 05 C 4004	Nutritional Biochemistry II	4	0	0	4
2.	SIAL NB 01 02 06 C 4004	Biostatistics and Research Methods	4	0	0	4
3.	SIAL NB 01 02 07 C 4004	Food Microbiology and Food Safety	4	0	0	4
4.	SIAL NB 01 02 08 C 00105	Practical II: Microbiology and Nutrient Analysis	0	0	10	5
5.	SIAL NB 01 02 03 GEC 0303	Bioinformatics (compulsory)	0	3	0	3
6.	NB DCEC	<i>Any one of the following two courses</i>	5	0	0	5
	SIAL NB 01 02 01 DCEC 5005	Nutraceuticals & Functional Foods				
	SIAL NB 01 02 02 DCEC 5005	Nutritional Toxicology				

Semester III

1.	SIAL NB 01 03 09 C 4004	Nutrient Deficiencies and Assessment	4	0	0	4
2.	SIAL NB 01 03 10 C 4004	Nutrition in Chronic Degenerative Diseases	4	0	0	4
3.	SIAL NB 01 03 11 C 0084	Practical III: Clinical & Biochemical Evaluation in Deficiencies & Diseases	0	0	8	4
4.	SIAL NB 01 03 03 DCEC 0202	Seminar Paper (compulsory)	0	2	0	2

5.	GE	<i>To be taken from other department</i>	4	0	0	4
6.	DCEC		5	0	0	5
	SIAL NB 01 03 04 DCEC 5005	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 03 04 GEC 4004	Nutrition in Chronic Degenerative Diseases	4	0	0	4
4.	SIAL NB 01 03 05 GEC 4004	Work Physiology, Physical Fitness & Health	4	0	0	4
5.	SIAL NB 01 03 06 GEC 4004	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 04 05 DCEC 4004	Nutrition & Immunity	4	0	0	4
2.	SIAL NB 01 04 06 DCEC 4004	Work Physiology, Physical Fitness & Health	4	0	0	4
3.	SIAL NB 01 04 01 SEEC 001616	Dissertation	0	0	16	16

"A dissertation/ project work/field work carries 16 credits (along with two Discipline Centric Elective Courses (DCEC)); and a semester-long dissertation/project work/field work carries 24 credits."

CORE COURSES
SIAL NB 01 01 01 C 5005: 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

14

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

Hematology

- 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 II: 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 III: Cardio-vascular Physiology

24

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

Gastro-intestinal Physiology

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

UNIT IV: 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, Stuart Ira. *Human Physiology*. New York, NY: Mcgraw Hill, 2006. Print
- Hall, John E., and Arthur C. Guyton. *Guyton and Hall textbook of medical physiology*. Philadelphia, PA: Saunders/Elsevier, 2011. Print.
- Gerad, J., Tortora and Sandra R. Grabowski. *Principles of Anatomy and Physiology, control systems of human body*, Vol-3, 10th edition, Wiley and Sons, 2006. Print
- Barrett, K.E., Barman, S.M., Boitans S. and Brook H. *Ganong's Review of Medical Physiology*, 23rd Edition (Lange basic science), Tata McGraw. 2009. Print

SIAL NB 01 01 02 C 5005: 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

16

- 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
- 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 II: 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 III: 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 IV: Amino acids and Proteins

18

- 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
- Inter Relationship Between Carbohydrate, Fat and Protein

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. 7th edition. New York, John Wiley and Sons.

**SIAL NB 01 01 03 C 5005: 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. 3rd 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.10th ed.Lipincott, William and Wilkins.
- Mahan LK and Escott- Stump S. (2008) Krause's Food and Nutrition Therapy. 12th ed. WB Saunders-Elsevier. USA.
- ILSI (2006). Present Knowledge in Nutrition. Ed. Bowman B A and Russel R M. 9th edition. ILSI Press, Washington, DC

**SIAL NB 01 01 04 C 00105: 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. 2nd 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 02 05 C 4004: 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 affecting electrolyte balance and hydrogen ion balance.

UNIT II: Vitamins

10

Vitamins A,D,E, K, 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

UNIT III: Minerals

16

Calcium, phosphorus, iron, iodine, fluoride, zinc, selenium, manganese, chromium–

- Distribution in the body
- Physiological Functions
- Digestion, Absorption, Utilization, Transport, Excretion, Factors affecting absorption
- Balance, Deficiency, Toxicity, Sources

- Regulation of serum calcium concentration, Calcium: Phosphorus ratio

UNIT IV: 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. 7th 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 02 06 C 4004: 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: Methods of Research

24

- 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
- Computer Applications: Using software to perform the statistical tests – EXCEL, SPSS, Atlas.ti

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 02 07 C 4004: 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

22

- 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)

Food Fermentation

- 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 II: Food borne Diseases

22

- 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

Enumeration and Control of Microorganisms in Food

- 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 III: 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 IV: 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

- Adams, M.R., Moss, M.O. and Peter McClure, P. *Food Microbiology*, RSC Publishing, 2015. Print
- Ray, B. and Bhunia A. *Fundamental Food Microbiology*, Fifth Edition, CRC Press, 2013, Print
- Frazier, W.C., and Westhoff, D.C. *Food Microbiology*, TMH, New Delhi, 2004. Print

- Jay and James M. *Modern Food Microbiology*, CBS Publication, New Delhi. 2000. Print
- Garbutt, J. *Essentials of Food Microbiology*, Arnold, London. 1997. Print
- Pelczar, M.J., Chan, E.C.S and Krieg, N.R., *Microbiology*, TMH, New Delhi, 1993. Print
- Lawley, R., Curtis, L. and Davis, J. *The Food Safety Hazard Guidebook*, RSC publishing. 2004. Print
- De Vries. *Food Safety and Toxicity*, CRC, New York. 1997. Print
- Marriott, N.G. *Principles of Food Sanitation*, AVI, New York, 1985. Print
- Forsythe, S.J. *Microbiology of Safe Food*, Blackwell Science, Oxford, 1987. Print
- Montville, T.J. and Matthews, K.R, *Food Microbiology: An Introduction*. ASM Press, Washington DC, USA. 2008. Print

SIAL NB 01 02 08 C 00105: 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. 2nd 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 03 09 C 4004: 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. 10th edition. Lipincott, William and Wilkins.
- Gibson R.S. (2005). Principles of Nutritional Assessment. 2nd edition. Oxford University Press.

**SIAL NB 01 03 10 C 4004: 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. 10th 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 03 11 C 0084: 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. 2nd edition. Oxford University Press..
- Raghuramulu N, Nair MK and Kalyansundaram S. (2003) eds. A manual of laboratory techniques. 2nd 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. 10th ed. Lipincott, William and Wilkins.

DISCIPLINE CENTRIC ELECTIVE COURSES (DCEC)

SIAL NB 01 02 01 DCEC 5005: 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 REC 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 SS and Dreher ML. (2001) Hand book Dietary Fibre. Marul Dekker Inc., Ney York
- Cupp J & Tracy TS. (2003) Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
- Gibson GR & William CM. (2000) Functional Foods - Concept to Product.
- Losso JN. (2007) Angi-angiogenic Functional and Medicinal Foods. CRC Press.
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- 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 GP. (2006) Dietary Supplements and Functional Foods. Blackwell Publ
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- Robert EC (2006) Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
- Brigelius-Flohé J & Joost HG. (2006) Nutritional Genomics: Impact on Health and Disease. Wiley VCH.
- Neeser JR & German BJ. (2004) Bioprocesses and Biotechnology for Nutraceuticals.
- Chapman & Hall Goldberg I.(1994). Functional Foods: Designer Foods, Pharma Foods Disease. Wiley VCH
- Liong MT.(2015) Beneficial Microorganisms in Food and Nutraceuticals. Springer International Publishing Switzerland
- Smith J & Charter E.(2010) Functional Food Product Development. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

**SIAL NB 01 02 02 DCEC 5005: 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 03 03 DCEC 0202: SEMINAR PAPER (COMPULSORY)

(CREDITS: 2)

**SIAL NB 01 03 04 DCEC 5005: 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.
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- 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.
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- 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.

SIAL NB 01 04 05 DCEC 4004: NUTRITION & IMMUNITY

(CREDITS: THEORY-4)

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 04 06 DCEC 4004: WORK PHYSIOLOGY, PHYSICAL FITNESS
AND HEALTH**

(CREDITS: THEORY-4)

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

20

- Exercise and thermo regulatory mechanism
- Fluid and electrolyte balance

Improving physical performance:

- 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. 4th 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. 2nd edition. CRC Press.

SKILL ENHANCEMENT ELECTIVE COURSES (SEEC)

SIAL NB 01 04 01 SEEC 001616: DISSERTATION

(CREDITS: 16)