

Department of Nutrition Biology
Master of Science in Nutrition Biology (Semester-wise Scheme 2019-2021)

Semester-I (Total credits - 24)

| Course code | Course title | L | T | P | Type of course | Credit |
|------------------------|---------------------------------------------------------------|---|---|----|----------------|--------|
| SIAL BT 1 1 01 C 3003 | Cell and Molecular Biology | 3 | 0 | 0 | Core | 3 |
| SIAL BC 1 1 01 C 3003 | Principles of Biochemistry | 3 | 0 | 0 | Core | 3 |
| SIAL MB 1 1 01 C 3003 | General Microbiology | 3 | 0 | 0 | Core | 3 |
| SIAL BT 1 1 02 C 3003 | Genetics | 3 | 0 | 0 | Core | 3 |
| SIAL SC 1 1 01 C 3003 | Analytical Techniques | 3 | 0 | 0 | Core | 3 |
| SIAL SC 1 1 02 C 00105 | Practical-I | 0 | 0 | 10 | Core | 5 |
| | Generic Elective Course (to be opted from another Department) | 4 | 0 | 0 | GEC | 4 |

Semester-II (Total credits - 30)

| Course code | Course title | L | T | P | Type of course | Credit |
|--------------------------|-----------------------------------------------------------|---|---|----|----------------|--------|
| SIAL BC 1 2 02 C 4004 | Immunology | 4 | 0 | 0 | Core | 4 |
| SIAL MB 1 2 02 C 3003 | Biosafety, Bioethics and IPR | 3 | 0 | 0 | Core | 3 |
| SIAL BT 1 2 03 C 4004 | Genomics and Genetic Engineering | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 2 01 C 4004 | Human Physiology | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 2 02 C 4004 | Nutritional Biochemistry and Metabolomics | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 2 03 C 00105 | Practical-II | 0 | 0 | 10 | Core | 5 |
| SIAL SC 1 2 03 DCEC 2002 | Research Methodology and Scientific Communication Skills* | 2 | 0 | 0 | DCEC | 2 |
| SIAL SC 1 2 04 DCEC 2002 | Bio-entrepreneurship* | 2 | 0 | 0 | DCEC | 2 |
| SIAL NB 1 2 01 DCEC 4004 | Nutritional Toxicology [#] | 4 | 0 | 0 | DCEC | 4 |
| SIAL NB 1 2 02 DCEC 4004 | Functional Foods and Nutraceuticals [#] | 4 | 0 | 0 | DCEC | 4 |
| SIAL NB 1 2 03 DCEC 4004 | Therapeutic Nutrition [#] | 4 | 0 | 0 | DCEC | 4 |

*One of the courses will be opted by student.

[#] One of the courses will be opted by student.

Semester-III (Total credits - 30)

| Course code | Course title | L | T | P | Type of Course | Credit |
|--------------------------|---------------------------------------------------------------|---|---|---|----------------|--------|
| SIAL SC 1 3 05 C 4004 | Biostatistics and Bioinformatics | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 3 04 C 4004 | Food Microbiology and Food Safety | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 3 05 C 4004 | Nutritional Requirements, Deficiency and Assessment | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 3 06 C 4004 | Nutrition in Metabolic Disorders | 4 | 0 | 0 | Core | 4 |
| SIAL NB 1 3 07 C 0084 | Practical-III | 0 | 0 | 8 | Core | 4 |
| SIAL NB 1 3 08 C 0202 | Seminar | 0 | 2 | 0 | Core | 2 |
| SIAL NB 1 3 04 DCEC 4004 | Food Biotechnology [#] | 4 | 0 | 0 | DCEC | 4 |
| SIAL NB 1 3 05 DCEC 4004 | Nutri-genomics [#] | 4 | 0 | 0 | DCEC | 4 |
| SIAL NB 1 3 06 DCEC 4004 | Sports Nutrition [#] | 4 | 0 | 0 | DCEC | 4 |
| | Generic Elective Course (to be opted from another Department) | 4 | 0 | 0 | GEC | 4 |

[#]One of the courses will be opted by student.

Semester-IV (Total credits - 20)

Skill Enhancement Course

| Course code | Course title | Type of course | Credit |
|-------------------------------------|--------------|----------------|------------|
| SIAL NB 1 4 01 SEEC 0020 | Dissertation | Core | 20 |
| Total credits of the Program | | | 104 |

L- Lecture; T- Tutorial P-Practical; C- Core course; DCEC - Discipline Centric Elective Course –opted by the student; SEEC- Skill Enhancement Elective Course; GEC- Generic Elective Course

Credit Summary of Courses Offered by Department of Nutrition Biology
(Academic Session 2019-21)

Total Credits: 104

| Semester | Credits | | | | Total credits |
|--------------|--------------|--------------------------|--------------------------------------------------------|----------------------------------------|---------------|
| | Core courses | Skill enhancement course | Elective courses | | |
| | | | DCEC (For Department of Nutrition Biology students) | GEC (For other Department students) | |
| I | 20 | - | - | 4 | 24 |
| II | 24 | - | 6 | - | 30 |
| III | 22 | - | 4 | 4 | 30 |
| IV | - | 20 | - | - | 20 |
| Total | 66 | 20 | 10 | 8 | 104 |

Generic Elective Course: Offered by Department of Nutrition Biology to students from other Departments of University.

| Semester | Type of course | Course code | Course title | Credit |
|------------|----------------|-------------------------|----------------------------------------------|--------|
| I | GEC | SIAL NB 1 1 01 GEC 4004 | Nutrition Immunity | 4 |
| | | SIAL NB 1 1 02 GEC 4004 | Work Physiology, Physical Fitness and Health | |
| III | GEC | SIAL NB 1 3 03 GEC 4004 | Food Microbiology and Food Safety | 4 |
| | | SIAL NB 1 3 04 GEC 4004 | Human Nutritional Requirements | |

SEMESTER-I

Course title: Cell and Molecular Biology

Credit: 3

Course code: SIAL BT 1 1 01 C 3003

Lectures: 45

Course objectives: To understand cellular organization and function at molecular level.

Learning Outcomes:

- Understanding of fundamental concepts of cellular and sub-cellular organization
- Molecular basis of genetic information and function

Unit-I

Archea, prokaryotic and eukaryotic cell (animal and plant cells); Theory of origin of eukaryotic cells; Structure and function of nucleus - nuclear envelope, nuclear pore complex; Nuclear protein-import and export, regulation of nuclear protein import and export; Organization of golgi, lysosome, structure and functions of ER, lysosome, mitochondria, chloroplasts and peroxisomes; Fluid mosaic model, membrane proteins, membrane lipids and membrane fluidity; Transport across cell membrane, passive transport, active transport-primary (P-type, F-type, V-type ATPases, ABC transporters), co-transport-symport and antiport; Ion channels, aquaporins, pinocytosis and phagocytosis; Cells as experimental models.

Unit-II

Introduction to cytoskeletal proteins; Organization of cytoskeletal protein and smooth muscle and skeletal muscles, movement of vesicles-role of actin and myosin; Structure of cilia and flagella; Prokaryotic and eukaryotic cell wall, cell matrix proteins; Cell-matrix interactions and cell-cell interactions; Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata; Signalling molecules, receptors and their functions – G protein coupled receptors- Cyclic-AMP, Cyclic-GMP, IP₃, Calcium, Receptor tyrosine kinases - EGF, insulin.

Unit-III

DNA as genetic material, forms of DNA; structure of various type of DNA; chromatin structure; super coiling; polytene and lamp brush chromosomes; properties of DNA in solution; denaturation and renaturation; reassociation reactions; COT curves; types of RNAs and their structures; role of RNA; Unusual bases in RNA; central dogma of molecular biology; DNA polymerases and other enzymes involved in replication; mutagenesis.

Unit-IV

Prokaryotic and eukaryotic gene structure: transcription-RNA polymerase, inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase, regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation, polynucleotide phosphorylase.

Suggested readings:

1. The Cell: A Molecular Approach (2018) 8th ed., Cooper, GM, Sinauer Associates is an imprint of Oxford University Press, ISBN: 1605357073.
2. Molecular Cell Biology (2016) 8th ed., Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J, W.H. Freeman & Company (New York), ISBN: 978-1-4641-0981-2 / ISBN:10: 1464183392.

3. Molecular Biology of the Cell (2008) 6th ed., Alberts B, Johnson A, Lewis J and Enlarge M, Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN:0-8153-1620-8.
4. Lehninger Principles of Biochemistry (2017) 7th ed., Nelson DL, Cox MM, W.H. Freeman and Company, New York, USA. ISBN-10: 1-4641-2611-9.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto, Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9
6. Genes XII, (2017) 12th Revised edition ed., Lewin B, Krebs J, Kilpatrick ST, Goldstein ES, Jones and Bartlett Publishers, Inc. Sudbury, Massachusetts, USA. ISBN No. 9781284104493.
7. Molecular Biology of the Gene (2013) 7th ed., Watson JD, Baker TA, Bell SP, Gann A, M, Levin RL and Cumming B, San Francisco, ISBN: 0321905377.

SEMESTER-I

Course title: Principles of Biochemistry

Course code: SIAL BC 1 1 01 C 3003

Credit: 3

Lectures: 45

Course objectives: To understand structures and functions of bio-molecules, metabolic pathways in the living systems.

Learning outcomes:

- Comprehensive knowledge of biochemical pathways-synthesis and catabolism of major biomolecules

Unit-I

Monosaccharides-structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Disaccharides: maltose, lactose and sucrose. Polysaccharides: homo and hetero-polysaccharides, structural and storage polysaccharides. Glycolysis - a universal pathway, reactions of glycolysis, production of acetyl CoA, reactions of citric acid cycle. Gluconeogenesis, glycogenesis and glycogenolysis.

Unit-II

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes-phospholipids, glycerophospholipids, galactolipids, sulpholipids, sphingolipids and sterols. β -oxidation of fatty acids. Fatty acid synthase complex. Synthesis of fatty acids.

Unit-III

Amino acids and peptides- classification (essential and non-essential amino acids), chemical reactions and physical properties. Introduction to protein structure and function. Enzymes: classification, kinetics (significance of k_m , k_{cat} and V_{max}), inhibition; amino acid metabolism-amino acid deamination and transamination, urea cycle. Synthesis and utilization of ketone bodies. Biosynthesis and breakdown of nutritionally non-essential amino acids. Synthesis of other amino acid derivatives such as neurotransmitters.

Unit-IV

Nucleotides - structure and properties. Nucleic acid structure-Watson - Crick Model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. De novo synthesis of purine and pyrimidine nucleotides. Catabolism of purine and pyrimidine. Disorders of purine and pyrimidine metabolism.

Suggested readings:

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
2. Biochemistry (2017) 6th ed., Garrett RH and Grisham CM, Brooks/Cole, ISBN: 9781305577206.
3. Harper's Illustrated Biochemistry (2018) 7th ed., Rodwell VW, Bender DA, Botham KM, Kennelly, PJ and Weil PA, McGraw-Hill, ISBN: 9781259837937.
4. Lippincott's Illustrated Reviews Biochemistry (2017) 7th ed., Ferrier, Wolters Kluwer India Pvt. Ltd., ISBN: 978-9351297949.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9.

SEMESTER-I

Course title: General Microbiology
Course code: SIAL MB 1 1 01 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an understanding of basic concepts and techniques in Microbiology.

Learning outcomes:

- Demonstrate the practical skills in basic microbiological techniques
- Designate the role of microorganisms in different ecosystems
- Retrieve and use contemporary information on different microbial groups

Unit-I

History of development of Microbiology in 20th century; The spontaneous generation controversy; Germ theory of disease; Methods in microbiology: Physical and chemical methods of sterilization; Pure culture techniques, maintenance and preservation of microbial cultures.

Unit-II

Binomial nomenclature; Haeckel's three kingdom classification; Organization of archae, bacteria and eukaryotic cell; Use of DNA and r-RNA sequencing in classification of microorganisms; Woese's three kingdom classification system and its utility - archaea, eubacteria, eukarya; Different groups of acellular microorganisms - viruses, viroids and prions.

Unit-III

General features of microorganisms - bacteria, algae, fungi and protozoa; Bacterial growth and metabolism; Microbes in different environment: extreme environment, deep ocean, space and air. Special features of the thermophilic, methanogenic and halophilic bacteria; Photosynthetic bacteria, Cyanobacteria.

Unit-IV

Scope of Microbiology - Cycle of matter in nature; Microbial interactions – Symbiosis and parasitism; Biodegradation and Bioremediation; Biofilms; Microbes in composting; Biofertilizers and Biopesticides; Microbes and Industry - SCP, microbial enzymes and fermented foods, Vaccines and antibiotics.

Suggested readings:

1. An Introduction to Microbiology (2019), 3rded., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG. New Age International Publishers. ISBN: 0852268785.
2. Brock Biology of Microorganisms (2018) 15thed., Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA Pearson Education, ISBN 9781292235103.
3. Prescott's Microbiology (2017). 10th ed. Sherwood LM, Woolverton C.J McGraw-Hill Education. ISBN 9781259281594.
4. A text book of Microbiology (2013), 3rd ed. Dubey, R.C. and Maheswari, D.K. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
5. Microbiology (2001) 5th ed., Pelczar Jr. M, McGraw Hill Education ISBN: 9780074623206.

SEMESTER-I

Course title: Genetics

Course code: SIAL BT 1 1 02 C 3003

Credit: 3

Lecture: 45

Course objective: To study the fundamental concepts of genetics and its role in unification of different disciplines of biology.

Learning outcomes:

- Understanding of basic concepts of classical genetics and genetic analysis of eukaryotes

Unit-I

Historical background, Principles of Mendelian inheritance, codominance, incomplete dominance, Gene interactions, pleiotropy, Extra chromosomal inheritance: Maternal inheritance (mitochondria and chloroplast), Sex linked inheritance, Sex influenced and Sex limited traits, Gene interactions: Incomplete dominance, codominance, duplicate genes, complementary genes, supplementary genes, lethal genes, pleiotropic genes and multiple alleles.

Unit-II

Linkage: complete and incomplete linkage, linkage analysis and genetic maps, Linkage and recombination of gene, Mechanism of crossing over, Population Genetics and Hardy-Weinberg equilibrium. Genetic analysis: Linkage maps, mapping with molecular markers, Gene mapping by three point test cross, Tetrad analysis, Sex determination and Dosage compensation in Mammals and Drosophila, Quantitative Genetics: Multilocus control; QTL analysis; Quantitative inheritance in plants and human.

Unit-III

Mutations: concept and types, Mechanism of spontaneous mutations, Physical and chemical mutagenesis, Selection and enrichment of mutants, Molecular mechanism of induced mutations, importance of mutation; detection of mutation and directed mutagenesis, Germinal and somatic mutation, insertion, deletion, duplication, translocation, transposition, Numerical alterations of chromosomes: Ploidy and their genetic implications. Types of DNA repair, Molecular mechanism of suppression.

Unit-IV

Nucleosome and chromatin structure, Structure of centromere and telomere, Euchromatin and heterochromatin, Polytene and lamp brush chromosomes, Gene transfer in prokaryotes: Transformation, Conjugation and Transduction, Transposons: types, structures and role in gene regulation, Natural and artificial competence, Operon concept in bacteria and gene regulation, Bacterial plasmids, Lytic and lysogenic cell cycles in Phages.

Suggested readings:

1. Principles of Genetics (2006) 8th ed. Gardner EJ, Simmons, MJ and Snustad DP, John Wiley & Sons Inc, ISBN: 8126510439.
2. Essentials of Genetics (2015) 9th ed. William S, Michael K, Cummings R, Spencer, CA and Palladino MA, Prentice Hall Internationals, ISBN-10: 0134047796
3. Genetics (2017) 9th ed. Daniel L. Hartal & B. Cochrane, ISBN: 128412293X
4. Introduction to Quantitative Genetics (1995) Falconer DS, and Mackay TFC, ISBN: 0582243025.

5. An Introduction to Population Genetics Theory and applications (2013) Nielsen R and Slatkin M, Oxford University Press, ISBN: 1605351539.
6. Evolution 4th ed. (2017) D. Futuma and M. Kirkpatrick, ISBN: 9781605356051
7. An Introduction to Genetic Analysis (2015) Griffith AJFJ, Wessler SR, Carroll SV and Doebley J, ISBN: 0-7167-3520-2.

SEMESTER-I

Course title: Analytical Techniques
Course code: SIAL SC 1 1 01 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an advanced understanding of the core principles of various techniques used in biological experiments.

Learning outcomes:

- Demonstrate principles of various basic and advanced techniques used in biological experiments
- Critically analyze and interpret the results obtained from biological experiments

Unit-I

Principle of microscopy: resolving powers of different microscopes, magnification; different types of microscopes, principle and applications of compound microscopy, dark microscopy, fluorescence microscopy, phase contrast microscopy, confocal microscopy, atomic force microscopy and electron microscopy (SEM, TEM, STEM); fixation and staining, freeze fracture/etch techniques.

Unit-II

Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native PAGE and SDS-PAGE); Western transfer, iso-electric focusing (IEF), 2-Dimensional gel electrophoresis, pulse field electrophoresis; principle and applications of centrifugation, differential centrifugation, density gradient centrifugation and ultracentrifugation; cell separation by flow cytometry.

Unit-III

Paper chromatography (ascending and descending, 2-Dimensional); principle and applications of thin layer chromatography (TLC), column chromatography (gel filtration, ion exchange and affinity chromatography); methods of ligand immobilization, immuno-adsorption-hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography, high performance liquid chromatography (HPLC) and gas liquid chromatography (GLC).

Unit-IV

Principle and instrumentation of UV-visible, infrared spectroscopy, atomic absorption spectrophotometry, NMR spectroscopy, X-ray diffraction spectroscopy, N-terminal sequencing and peptide synthesis, introduction to proteomics, Yeast 2- hybrid and 3-hybrid systems, EMSA, foot printing, phage display, principle of mass spectrometry, electrospray ionization MS, MALDI, tandem MS for protein identification, ICAT-MS.

Suggested readings:

1. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K and Walker J, Cambridge University Press, ISBN No. 131661476X.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder D, W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

SEMESTER – I

Course Title: Practical-I
Course Code: SIAL SC 1 1 02 C 00105

Credit: 5
Lecture: 150

1. Laboratory orientation, calibration, and demonstration of equipment.
2. Solutions, pH and buffers
3. Determination of pKa of acetic acid and glycine
4. Qualitative tests for carbohydrates, lipids, amino acids, and proteins in food samples
5. Metaphase chromosome preparation with G banding and C banding from blood sample
6. RNA *in-situ* hybridization to study gene expression in tissue section
7. Inheritance patterns in man – numerical on pedigree analysis- autosomal patterns, X–linked patterns, Y–linked patterns, mitochondrial inheritance patterns
8. Numerical on Hardy-Weinberg equilibrium
9. Numerical on linkage mapping
10. Different staining methods and microscopic examination of bacteria, actinomycetes, algae, fungi and protozoa
11. Preparation of specific media for isolation of bacteria, and fungi from natural sources
12. Cell counting and cell viability assay
13. Production of microbial enzymes (amylase, phosphatase) and their separation using chromatographic techniques
14. Biochemical characterization of microbial enzymes.
15. Separation of carbohydrates, amino acids and plant pigments using paper/thin layer chromatography
16. Detection of food adulterants
17. Evaluation of microbiological risks in food processing unit through microbiological risk assessment (MRA) tools
18. Assessment of nutritional status of different age group using anthropometric tools

Suggested readings:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D, Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
2. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, D.T., McGraw Hill Education, ISBN: 978-0070994874.
3. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K, and Walker J, Cambridge University Press. ISBN: 131661476X.
4. Microbes in Action: A Laboratory Manual of Microbiology (1990) 4th Addition, Harry W, Seeley, Paul JV, John J, W. H. Freeman ISBN: 978-0716721000.
5. Genetics: A Laboratory Manual, (2009) 2nd ed., American Society of Agronomy; Lab Manual edition, ISBN: 978-0891185611.

SEMESTER – I

Course title: Nutrition and Immunity
Course code: SIAL NB 1 1 01 GE 4004

Credit: 4
Lectures: 60

Course objective: To provide knowledge on fundamental concepts of nutrition, immunity and diseases.

Learning outcomes:

- Understanding the relationship between nutrition, immunity and infection
- Comprehensive knowledge about the role of different nutrients in enhancing immunity
- Understanding Relationship between disease and immunity

Unit-I

Terminology related to immunity, introduction to infections and immunity, classification and history, overview of the auto defence mechanisms of the human body, cell and organs related immune system, Phagocytes their role and structure, antigen and antibodies, reaction between antigen and antibody, assessment of the immune response.

Unit-II

Interrelationship between nutrition and immunity. Effect of malnutrition i.e under and over nutrition on immune system. Different macro and micro nutrients and their relationship with immunity. Effect of amino acids on immunity. Antioxidants and immunity. Role of vitamins in immune functions and effect of deficiency, effect of deficiency and excess of vitamins and minerals on immune cell functions, 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

Immune system: diseases, disorders and functions, effect of different disease and disorders on the immunity level of persons: allergies, autoimmune diseases, other diseases linked to immune system viz., autoimmune polyglandular syndrome, leukemia, chronic myeloid and ataxia telangiectasia.

Unit-IV

Probiotics and antioxidants – their effect on immune system. Immunity against infection – role of immunization. Maternal & children nutrition - Infections and birth outcomes immunity & infections of infants and children, Impact of breast feeding on immunity of infants, Immunization, prevention of communicable diseases, Relationship of Probiotics, prebiotics with immunity and nutrition.

Suggested readings:

1. Handbook of Nutrition and Immunity (2017) 1st ed., Gershwin ME, Nestel P, Keen CL, Humana Press, DOI: 10.1007/978-1-59259-790-1, ISBN: 9781592597901
2. Nutrition-Infection Interaction and Impact on Human Health (2016) 1st ed., Pammi M, Vallejo JG and Abrams SA, CRC Press, Taylor & Francis Group, ISBN 9781138033764
3. Diet, Immunity and Inflammation (2013) 1st ed., Calder P and Yaqoob P, Woodhead Publishing ISBN: 9780857095749
4. Nutritional Modulation of Immune Function: Analysis of Evidence, Mechanisms, and Clinical Relevance (2019) Wu D, Lewis ED, Pae M and Meydani SN, Front Immunol. 15;9:3160. doi: 10.3389/fimmu.2018.03160. eCollection 2018. Review. PMID:

30697214

5. Host and Microbe-Dependent Dietary Lipid Metabolism in the Control of Allergy (2019)
Saika A, Nagatake T, Kunisawa J. *Front Nutr.* 10;6:36. doi: 10.3389/fnut.2019.00036.
eCollection 2019. Review. PMID: 31024921

SEMESTER – I

Course title: Work Physiology, Physical Fitness and Health

Credit: 4

Course code: SIAL NB 1 1 02 GE 4004

Lectures: 60

Course objective: To provide an understanding of effect of physical activity on body composition, fitness and health.

Learning outcomes:

- Understanding the concepts & components of health and physical fitness
- Comprehensive knowledge of energy metabolism during exercise or physical activity
- Understanding the importance of maintaining thermoregulation, fluid & electrolyte balance

Unit-I

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, prevention of obesity and its co-morbidities, techniques to assess physical fitness, Aging theories, physiology, mechanism and role of nutrients in arresting aging process

Unit-II

Body composition, Methods of measuring body composition: direct and indirect. Body composition in different physiological conditions, factors affecting body composition, muscle - structure, muscle classification and types of muscle contraction, major muscles of neck, shoulder, arms, chest, abdominal, back, hip and lower limbs, principles of muscle mechanics, Introduction of weight training, significance and principles of weight training, Do's and Don'ts of weight training

Unit-III

Energy metabolism and physical fitness: concept, importance, influencing factors, Techniques to measure energy expenditure and energy intake, types of energy systems, energy continuum and energy release, cardiovascular response to training and measurement of anaerobic & aerobic capacity, concept of isotonic/isometric/isokinetic exercises, various isotonic, isometric and isokinetic exercises for various muscles of the body, weight training exercises for the women, elderly people and for competitive sports person.

Unit-IV

Exercise and thermo regulatory mechanism, fluid and electrolyte balance, improving physical performance, Ergogenic aids: definition, market, types and effects, exercise and the neuroendocrine system, body composition and fat estimation calculation of kilocalories, harmful effects of quick weight reduction, Scientific approaches of weight reduction.

Suggested readings:

1. Alvero JC, Ronconi M, García JR, Carrillo MD, Jiménez ML, Correas LG, Álvarez EC. (2017) Body composition changes after sport detraining period. *Nutricion hospitalaria*. 34(3):632-8.doi: 10.20960/nh.618.
2. Mazzocoli G. Body composition: Where and when. *European journal of radiology*. 2016 Aug 1;85(8):1456-60.doi: 10.1016/j.ejrad.2015.10.020. Epub 2015 Oct 31
3. *Essentials of Exercise Physiology* (2015) 5th edition, William D. McArdle BS,

M.Ed, PhD, Frank I. Katch EdD, Victor L. Katch EdD, Publisher: Wolters Kluwer, ISBN/ISSN 9781496302090

4. Textbook of Work Physiology: Physiological Bases of Exercise (2003) 4th Edition, Per-Olof Astrand , Kaare Rodahl, Hans A. Dahl , Sigmund B. Stromme. Publisher: Champaign (Ill.) : Human kinetics, 2003 ISBN: 0736001409
5. Nutrition in Exercise and Sport 3nd edition (1997) Ira Wolinsky, CRC Press. ISBN 9780849385605

SEMESTER-II

SEMESTER-II

Course title: Immunology
Course code: SIAL BC 1 2 02 C 4004

Credit: 4
Lecture: 60

Course objective: To understand overall organization of the immune system and to identify the cellular and molecular basis of immune responsiveness.

Learning outcomes:

- Understanding the working mechanism of the immune system
- Understanding of antibody, MHC, complement system, cytokines, cancer, and organ transplant hypersensitivity

Unit-I

Host-defenses, hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, chemokines. Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit-II

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response.

Unit-III

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit-IV

Mechanism of tolerance, Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy, Immunohistochemistry, Immunocytochemistry and privileged sites. Vaccines - active and passive immunization, types of vaccines.

Suggested readings:

1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
2. Janeway's Immunobiology (2017) 9th ed., Murphy KM and Beaver C, WW Norton and Company, ISBN: 978-0815345510.
3. Roitt's Essential Immunology (2017) 13th ed., Delvis PJ, Martin SJ, Burton DR and Roitt, IM, Wiley-Blackwell, ISBN: 978-1118415771.

4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
5. Lippincott's illustrated Reviews Immunology (2012) 2nd ed., Doan T, Melvold R, Viselli S and Waltenbaugh, C, Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.

SEMESTER-II

Course title: Biosafety, Bioethics and IPR

Course code: SIAL MB 1 2 02 C 3003

Credit: 3

Lecture:45

Course objective: To introduce the concept of intellectual property rights, patenting and emphasis on biosafety and bioethics.

Learning outcomes:

- Understanding the basics of intellectual property rights
- Understand the importance and level of biosafety at laboratory and industrial levels
- Understand ethical practices and concepts appropriate to the discipline

Unit-I

Biosafety: introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools. Regulations: International regulations-Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations-EPA act and rules, guidance documents, regulatory framework-RCGM, GEAC, IBSC and other regulatory bodies.

Unit-II

Bioethics: Introduction, ethical conflicts in biological sciences-interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research - cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology-Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity - biopiracy.

Unit-III

Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications, PCT and conventional patent applications.

Unit- IV

International patenting-requirement, procedures and costs; financial assistance for patenting, introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing-outright sale, licensing, royalty; patenting

by research students and scientists-university/organizational rules in India and abroad, collaborative research-backward and forward IP; benefit/Credits sharing among parties/community, commercial (financial) and non-commercial incentives.

Suggested readings:

1. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. <http://www.ipindia.nic.in/>
2. World Trade Organisation. <http://www.wto.org>
3. World Intellectual Property Organisation. <http://www.wipo.int>
4. International Union for the Protection of New Varieties of Plants. <http://www.upov.int>
5. National Portal of India. <http://www.archive.india.gov.in>
6. IPR, Biosafety and Bioethics (2013) Parashar S, Goel D, Pearson Publishing India, ISBN: 9788131774700.
7. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology (2017) Nambisan P, Academic Press, ISBN: 9780128092316.
8. <http://dbtindia.gov.in/guidelines-biosafety>

SEMESTER-II

Course title: Genomics and Genetic Engineering

Credit: 4

Course code: SIAL BT 1 2 03 C 4004

Lecture: 60

Course objective: To provide basic and high throughput techniques in the areas of genomics and genetic engineering.

Learning outcomes:

- Understanding of high throughput techniques used in genomics and transcriptomics
- Understand concept of genetic engineering including the techniques, applications and limitations
- Demonstrate the ability of designing recombinant molecules and conducting experiments involving genetic manipulation

Unit-I

Origin of genomics: The first DNA genomes, Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes, Microbial genomes (including yeast), Plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human), Genomes and human evolution, The concept of minimal genome. Genetic maps, Physical maps, EST and transcript maps, Functional maps and Functional genomics, Human genome project-landmarks on chromosomes generated by various mapping method, Comparative genomics and colinearity/synteny in maps, Genetic variation polymorphism, deleterious mutation; FISH to identify chromosome landmarks.

Unit-II

BAC libraries and shotgun libraries preparation (shotgun sequencing); Clone-by-clone or 'hierarchical shotgun' Sequencing, Next Generation sequencing, Genomics in medical practice, personalized medicine, use of SNP in pharmacogenomics, DNA Microarray technology: Basic principles and design, Global gene expression analysis, Comparative transcriptomics, Differential gene expression.

Unit-III

Recombinant DNA Technology: Enzymes used in Recombinant DNA technology (Restriction endonucleases, DNA modifying enzymes, other nucleases, Polymerases, Ligase, kinases and phosphatases), Isolation and purification of DNA (genomic and plasmid) and RNA. Various methods of separation, characterization of nucleic acids including Southern and Northern hybridizations, Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors and their purification.

Unit-IV

Western blotting, generation of genomic and cDNA libraries. plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Isolation and amplification of specific nucleic acid sequences, PCR, RT-PCR and qRT-PCR, DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. Site-directed Mutagenesis, protein engineering. Applications of genetic engineering in plants and animal improvements.

Suggested readings:

1. Principles of Gene Manipulation and Genomics (2016) 8th ed., Primrose, SB and Twyman, R, Wiley Blackwell, ISBN: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction (201978-6) 7th ed., Brown, TA, Wiley Blackwell, ISBN: 978-1119072560.
3. Genome 4 (2017) 4th Brown, TA, Garland science, ISBN 13: 978-0815345084.
4. Introduction to Genomics (2015) 2nd ed., Lesk, AM, Oxford university Press India, ISBN: 978-0198745891.
5. Genomics and Personalized Medicine: What Everyone needs to Know (2016) 1st ed., Snyder, M, OUP-USA, ISBN: 978-0190234768.

SEMESTER-II

Course title: Human Physiology
Course code: SIAL NB 1 2 01 C 4004

Credit: 4
Lectures: 60

Course objectives: To introduce the physiological concepts of homeostasis and control mechanisms and to study the functions of body systems with emphasis on clinical relevance.

Learning outcomes:

- Understanding of all aspects of general and systemic physiology.
- Understanding of physiological mechanisms of the human body and Patho-physiological processes of diseases.

Unit-I

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, blood disorders- Anemias, Polycythemias, Leucopenia, Leukemias, Thalassemia.

Unit-II

Body fluid compartments, water balance-regulation of fluid balance, Urine formation, Regulation of extra cellular 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

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

Classification of hormones and mechanism of hormone action, Endocrine function of the hypothalamus, Pituitary, Thyroid, Adrenals, Endocrine pancreas, Pathophysiology of diabetes, Male and female sex hormones, Hyper and hypogonadism.

Suggested readings:

1. Fox, Stuart Ira, Human Physiology, 14th edition New York, NY, Mcgraw Hill (2016).
2. John E. Hall, Guyton and Hall Textbook of Medical Physiology (Guyton Physiology), 13th edition, Saunders (2015).
3. Gerad,J., Tortora and Sandra R. Grabowski. Principles of Anatomy and Physiology, control systems of human body, 10th edition, Wiley and Sons (2003).
4. Anne Waugh and Allison Grant, Ross and Wilson Anatomy and Physiology, 13th edition, Elsevier (2018).
5. Human Physiology, Biochemistry and Basic Medicine by Laurence A. Cole, Peter R. Kramer (2017) Academic Press, Elsevier ISBN 978-0-12-803689-0

SEMESTER-II

Course title: Nutritional Biochemistry and Metabolomics

Credit: 4

Course code: SIAL NB 1 2 02 C 4004

Lectures: 60

Course objectives: To introduce the concepts of basic metabolism of nutrients and their relationships.

Learning outcomes:

- Understanding the properties and role of micro and macronutrients
- Understanding the inter-relationship between carbohydrates, proteins and fats

Unit-I

Carbohydrates: classification, digestion, absorption, transport, utilization and storage. Important metabolic pathways and regulations (glycolysis; tca cycle; electron transport chain and oxidative phosphorylation; glycogen and glycoprotein metabolism); regulation of blood glucose level, inborn errors of carbohydrate metabolism- glycogen storage diseases, lactose intolerance, galactosemia, fructose intolerance.

Unit-II

Lipids: digestion, absorption, deposition and storage. Role of essential fatty acids and lipoproteins, role of omega fatty acids, oxidation of fatty acids and biosynthesis, metabolism of triglycerides, cholesterol: properties, biosynthesis, metabolism and functions, role of liver in lipid metabolism, utilization and synthesis of ketone bodies, lipotropic factors, fatty liver.

Unit-III

Proteins: digestion, absorption, and nitrogen metabolism, protein denaturation, inborn errors of amino acid metabolism- PKU, tyrosinemias, alkaptonuria, albinism, inter-relationship between carbohydrate, fat and protein. Vitamins and Minerals: digestion, absorption, utilization, transport, excretion, factors affecting absorption, deficiency, toxicity, sources.

Unit-IV

Analytical methods: GC, HPLC, Mass spectrometry; NMR, FT-IR; chromatography and electrophoresis; nucleic acid metabolism, metabolomics in nutrition, next-generation nutritional biomarkers, metabolomics resources and analysis: tools, software, libraries, databases, experiment repositories, and meta-data storage.

Suggested readings:

1. Wise S, Phillips. "Evolution of reference materials for the determination of organic nutrients in food and dietary supplements-a critical review." *Anal Bioanal Chem.* 2019 Jan;411(1):97-127. doi: 10.1007/s00216-018-1473-0. Epub 2018 Dec 1.
2. Lehninger Principles of Biochemistry (2012) 7th ed. Nelson DL and Cox MM, W.H. Freeman & Com. ISBN-13: 978-1-4641-2611-6
3. Harpers Illustrated Biochemistry (2015) 31st ed. Victor WR, David AB, Kathleen MB, Peter JK and Weil PA, Lange, ISBN: 978-1-260-288421
4. Molecular Cell Biology (2013) 4th ed., Lodish H, Berk A, et al, W.H. Freeman and Company, (New York) ISBN: 0-7167-3136-3
5. Shrimanker I, Bhattarai S. Electrolytes. [Updated 2019 May 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Available from: <https://www.ncbi.nlm.nih.gov/books/NBK541123/>
6. Core Concepts in the Disorders of Fluid, Electrolytes and Acid- Base Balance, (2013) Jeff M, Sands MD, David B, Mount MD (auth.), David BM, Mohamed HS, Singh AK (eds.), Springer US., ISBN: 978-1-4614-3769-7,978-1-4614-3770

SEMESTER-II

Course title: Practical-II
Course code: SIAL NB 1 2 03 C 00105

Credit: 5
Lectures: 150

1. Qualitative analysis of sugars.
2. Biochemical examination of body fluid
3. Guidelines and practices related to biosafety
4. Detection of nutritional biomarkers in body fluids
5. Analysis of anti-nutrients in food
6. Extraction and isolation of nutraceuticals
7. Isolation and screening of potential probiotic microorganisms
8. Effect of prebiotics on the growth of selected probiotic microorganisms
9. Dietary assessment methods in epidemiological studies
 - a. Duplicate diet approach
 - b. Food frequency questionnaire
 - c. Food consumption record
 - d. 24-Hour dietary recall
 - e. Dietary record
10. Planning a diet for Cancer, Hepatitis and Arthritis Patients
11. Assessment of Protein quality of Dishes and meals by various indices- NDp Cal% and PDCAAS
12. Diet plan for different age groups.
13. Food exchange list.

Suggested readings:

1. A manual of laboratory techniques. (2003). 2nd edition. Raghuramulu N, Nair MK and Kalyansundaram S, Publisher:Hyderabad : National Institute of Nutrition, ICMR.
2. Qualitative Tests and Quantitative Procedures in Biochemistry : A Practical Manual (2002) Revised ed. Sundararaj P and Siddhu A, Phoenix Publishers ISBN 13: 9788174840622
3. Proteomics of Human Body Fluids: Principles, Methods, and Applications 2007, 1st edition, Visith Thongboonkerd, Publisher: Humana Press, DOI: 10.1007/978-1-59745-432-2, ISBN: 978-1-59745-432-2
4. Shim JS, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. *Epidemiol Health*. 2014;36:e2014009. Published 2014 Jul 22. doi:10.4178/epih/e2014009

SEMESTER-II

Course title: Research Methodology and Scientific Communication Skills Credit: 2

Course code: SIAL SC 1 2 03 DCEC 2002

Lectures: 30

Course objective: To provide knowledge about tools and techniques related with scientific communication and research methodology.

Learning outcomes:

- Understanding the existence of scientific knowledge in ancient times
- Acquiring the skills of scientific reading, writing and presentations
- Appreciating the scientific ethics through case studies

Unit-I

Empirical science; scientific method; manipulative experiments and controls; deductive and inductive reasoning; descriptive science; reductionist vs holistic biology.

Unit-II

Choosing a mentor, lab and research question; maintaining a lab notebook. Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication- interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences.

Unit-III

Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

Unit-IV

Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Suggested readings:

1. Research Methodology: Methods And Techniques (2019) 4th ed., Kothari CR and Garg G, New Age International Publishers, ISBN: 978-9386649225.
2. Communicate Science Papers, Presentations, and Posters Effectively (2015) Patience GS, Boffito DC, Patience P, Academic Press, ISBN: 978-0128015001.

3. **Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences** (2014) 4th ed., Matthews JR and Matthews RW, Cambridge University Press ISBN: 978-1107691933.
4. **Doing Science: Design, Analysis, and Communication of Scientific Research.** (2001) Valiela I, Oxford: Oxford University Press, ISBN 10:019538573X.
5. **On Being a Scientist: a Guide to Responsible Conduct in Research.** (2009) 3rd ed., Washington DC, National Academies Press.

SEMESTER-II

Course title: Bio-entrepreneurship
Course code: SIAL SC 1 2 04 DCEC 2002

Credit: 2
Lectures: 30

Course objectives: To teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.

Learning Outcomes:

- Gain entrepreneurial skills and understand the various operations involved in venture creation
- Identifying scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies

Unit-I

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities. For innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Unit-II

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

Unit-III

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

Unit-IV

Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

Suggested readings:

1. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge, Routledge Studies in Innovation, Organizations and Technology (2018) 1st ed. Onetti, A, & Zucchella, A, CRC press, Taylor and Francis group. ISBN: 9781138616905.
2. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Shimasaki, CD (2014) Amsterdam: Elsevier. Academic Press is an imprint of Elsevier, ISBN: 0124047300.

3. Innovation, Commercialization, and Start-Ups in Life Sciences. (2014) 1st ed. Jordan, JF, CRC Press. Taylor and Francis group, ISBN: 9781482210125.
4. The Dynamics of Entrepreneurial Development and Management. (2011) 6th ed., Desai V, New Delhi: Himalaya Pub. House, ISBN: 9350244543.
5. Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences (2008) Adams, DJ, Sparrow JC, Bloxham, Scion, ISBN:1904842364.

SEMESTER-II

Course title: Nutritional Toxicology
Course code: SIAL NB 1 2 01 DCEC 4004

Credit: 4
Lectures: 60

Course objectives: To provide profound knowledge on the basic principles of toxicology and how different toxicants affect human health.

Learning outcomes:

- Identify and describe different sources of toxicity in the food supply
- Describe toxic effects of nutrients eaten in excess of requirements
- Understanding the relationship between nutrient uptake and drug bioavailability

Unit-I

Introduction to basic terms in toxicology, general principles of toxicology, classification of toxicants, mechanisms of toxicants, nature and complexity of food, antinutritional substances in food, overview of methods of toxicity testing (in vivo and in vitro studies), concept of risk analysis, steps involved in risk assessment.

Unit-II

Physical, chemical and biological hazards- types, sources, potential toxic effects of different hazards, naturally present toxicants in foods and their repair mechanism, foodborne illness – causes, prevention, treatment microbial toxins: types, properties, mode of action and toxin inactivation, food allergies and intolerances, food poisoning, types, causative factors, symptoms and prevention, anti-nutritional factors their course of action, harmful effects and their mitigation.

Unit-III

Toxicity of Vitamins, minerals and dietary supplements, Food additives toxicity, Safety Determination of direct and indirect Food Additives, concept of Generally Regarded as Safe (GRAS), Acceptable Daily Intake (ADI), Estimated daily intake (EDI), adverse health effects of different additives, role of Joint FAO/WHO Expert Committee on Food Additives (JECFA) in assessing safety of food additives, Regulatory aspects of additives (FSSAI regulation).

Unit-IV

Disease states/drugs and nutrient deficiency, Food–Drug Interactions: mechanism of action, Interactions of drugs, food, alcohol and nutraceuticals, Strategies for prevention and management. Food packaging material, potential contaminants from food packaging material. Food laws and standards: Farmer Producer Organisation (FPO), ISI, Ag Mark, Codex Alimentarius, ISO, mark for vegetarian and non vegetarian foods, eco-friendly products and others in operation Carcinogens and carcinogenesis, Process-induced toxic compounds; nitrites, nitrates, and nitrosamines, lipid oxidation, Toxic components in foods of marine origin.

Suggested readings:

1. Food toxicology: quantitative analysis of the research field literature. Yeung AWK, Tzvetkov NT, Jóźwik A, Horbanczuk OK, Polgar T, Pieczynska MD, Sampino S, Nicoletti F, Berindan-Neagoe I, Battino M, Atanasov AG. Int J Food Sci Nutr. 2019 May 29;1-9. doi: 10.1080/09637486.2019.1620184. [Epub ahead of print] PMID: 31140340
2. Food and Nutritional Toxicology (2004) 1st ed., Stanley TO, CRC Press, Boca Raton, FLA., ISBN :1587160714, 9781587160714.
3. Food safety: The science of keeping food safe. (2013) Shaw IC Wiley-Blackwell, ISBN: 144433722X.

4. Principles of Food Toxicology (2013) 2nd ed., Püssa T, CRC Press, ISBN: 9781466504103.
5. Nutritional Toxicology Nutrition: Basic and Applied Science Series (2012), Volume 1, Hathcock, J.N. Publisher: Elsevier, ISBN: 0323146937, 9780323146937
6. Food Safety (Point Counterpoint) (2015) 3rd ed., Sherrow V, ISBN, 0791092895, 9780791092897, 978143810612.

SEMESTER-II

Course title: Functional Foods and Nutraceuticals

Credit: 4

Course code: SIAL NB 1 2 02 DCEC 4004

Lectures: 60

Course objective: To provide enormous knowledge on role of nutraceutical and functional foods in human diet. The course will also provide an understanding of recent advancements in formulation and processing of functional foods.

Learning outcomes:

- Understanding fundamental concepts and knowledge related to functional foods
- Critically evaluation of the mechanism of action and health benefits of different types of nutraceuticals
- Understanding national and international regulations regarding nutraceuticals

Unit-I

Definition and examples of nutraceuticals, functional foods, dietary supplements, fortified foods (scope and relevance), Classification of nutraceuticals, according to source of origin: phyto-nutraceuticals, animal origin, microbial, algal, Nutrient and non-nutrient, Probiotic, prebiotic and synbiotic. Extraction and isolation of nutraceuticals, Perspective for food applications.

Unit-II

Recent advancements in formulation and processing of functional foods, Nanotechnology and functional food. Cellular and molecular mechanisms of action of different types of nutraceuticals relative to their Bioavailability and bio-accessibility, Absorption, disposition, metabolism and elimination of nutraceuticals, Functional foods and nutraceuticals for chronic disease prevention, Adverse effects and toxicity, Gut microbiota, metagenomics.

Unit-III

Probiotics: Important features of probiotic micro-organisms, Conventional and non-conventional probiotics; Designer probiotics; Health effects including mechanism of action, use in various foods: fermented milk products, non-milk product 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 (soluble and insoluble), resistant starch (types and functions), gums; role of short-chain fatty acids; Bio-active proteins and peptides; omega fatty acids in health, Synbiotics: Important features of synbiotics, Health effects including mechanism of action, use in various foods, effects on human health and potential applications in risk reduction of diseases, Perspective for food applications.

UNIT-IV

Important regulatory authorities/bodies and Regulations on functional foods/nutraceuticals: FAO, EFSA and FSSAI; Indian regulations for nutraceuticals/functional foods, Quality assurance of probiotics and safety, ICMR Guidelines on Probiotics, Consumer acceptance –issues for the future. Regulatory compliance, health claims and labelling

Suggested readings:

1. Functional foods and Nutraceuticals (2012), 1st ed., Rotimi EA, Springer Publications. ISBN: 0213657854658.
2. Probiotics: current landscape and future horizons. Day RL, Harper AJ, Woods RM, Davies OG and Heaney LM. Future Sci OA. 2019 May 3;5(4):FSO391. doi:

10.4155/fsoa-2019-0004. Review. PMID: 31114711.

3. Probiotics, prebiotics, and microencapsulation: A review. Sarao LK and Arora M, *Crit Rev Food Sci Nutr.* 2017 Jan 22;57(2):344-371.
4. Innovation in Healthy and Functional Foods (2016) 1st edition, Ghosh D, Das S, Bagchi D, Smarta RB, CRC Press, London, DOI <https://doi.org/10.1201/b13022>
eBook ISBN9780429189401
Nutraceuticals and Functional Food Components (2017), 1st ed., Galankis C, Academic press., ISBN: 9780128052570.
5. Genomics, Proteomics, and Metabolomics in Nutraceuticals and Functional Foods, (2010) Debsis Bagchi, Francis Lau, Manashi Bagchi., Wiley-Blackwell Publishers., ISBN: 0813814022, 9780813814025
6. Functional Foods, Nutraceuticals and Degenerative disease prevention (2011) 1st edi., Gopinadhan P, Bakovic M and Shetty K, Wiley-Blackwell, ISBN: 0812824532, 978081324536, 9780470960844
7. Functional Foods: Concept to Product (2011) 1st edi., Saarela M, Woodhead Publishing., ISBN: 1845696905, 9781845696900
8. Beneficial Microorganisms in Food and Nutraceuticals. (2015) 1st ed., Liong MT, Springer International Publishing Switzerland, ISBN: 3319231766.

SEMESTER-II

Course title: Therapeutic Nutrition
Course code: SIAL NB 1 2 03 DCEC 4004

Credit: 4
Lectures: 60

Course objective: To provide an understanding of role of therapeutic nutrition for the management of various diseases

Learning outcomes:

- Understanding the principles of meal planning
- Critical assessment of nutritional state and surveillance
- Understanding the role of diet in management of diseases

Unit-I

Introduction to meal management, principles of meal planning, factors affecting meal planning, steps involved in meal planning, food exchange list(s), concept of food exchange list in meal planning, comprehensive food exchange list, diet plan for preschool and school children, adult man, woman and elderly, balanced diet, food groups, planning of balance diet, food guides, diet therapy, diet & stress in current scenario. Food faddism & the faulty food habits, Nutritive value of common Indian foods.

Unit-II

Nutrition in pregnancy - physiological stages of pregnancy, nutritional requirements, complication of pregnancy diet during pregnancy, nutrition during lactation - physiology of lactation, nutritional requirements, nutrition during infancy - growth & development, nutritional requirements, breast feeding, infant formula, introduction of supplementary foods. nutrition during early childhood (toddler/preschool)- growth & nutrient need, nutrition related problems, feeding patterns, nutrition of school children- nutritional requirement, nutrition during adolescence - growth & nutrient needs, food choices, eating habits, nutrition during adulthood - nutritional requirements, geriatric nutrition: factors affecting food intake and nutrient use, nutrient needs, nutrition related problems.

Unit-III

Nutritional problems in emergencies in vulnerable groups, macro and micronutrient deficiencies, infection, nutritional assessment and surveillance. Nutrition care process, nutritional screening and assessment of patients – out patient & hospitalized. Nutrition care plan and implementation. monitoring and follow up, ethical issues, dietary counselling. Nutritional relief and rehabilitation – assessment of food needs, food distribution strategy, mass and supplementary feeding, sanitation and hygiene, evaluation of feeding programs. Nutritional approach to tackle nutrition problems in emergencies. Therapeutic diets (clear fluid, full fluid, soft diet and Regular normal diet), types of hospital diets, diet in different diseases namely cancer, obesity, hypertension, hypotension, hyper and hypothyroidism, peptic ulcer, arthritis and stone patients

Unit-IV

Overview of enteral and parenteral nutrition in Indian context, principles underlying enteral and parenteral feeding, constituents of enteral and parental nutrition formulations, types of enteral and parenteral formulations, access techniques and devices available for enteral and parenteral feeding, formulation of guidelines, ethical issues and legal considerations, complications of enteral feeding overview of diseases, etiology, symptoms and its dietary management of cancer, Alzheimer's disease, Parkinson's disease, HIV-AIDS and Rheumatoid arthritis.

Suggested readings:

1. Nutrition, Gut Microbiota and Immunity: Therapeutic Targets for IBD: 79th Nestlé Nutrition Institute Workshop, New York, N.Y., September 2014 J.D. Lewis, F.M. Ruellemele, G.D. Wu Nestlé Nutrition Institute Workshop Series, Vol. 79, 3318026697, 9783318026696
2. Krause's Food & Nutrition Care Process (2017) 14th edi., L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CD, Saunders-Elsevier. ISBN: 9780323340755
3. Food, Nutrition, Physical Activity and the Prevention of Cancer- A Global Perspective. (2007) Washington E.D. WCRF (World Cancer Research Fund & American Institute for Cancer Research) Available from: <http://discovery.ucl.ac.uk/4841/1/4841.pdf>
4. Nutritional Assessment 2013, 6th edition, Robert D. Lee, David C. Nieman, McGraw Hill Higher Education ISBN-13: 9780071326360
5. Integrating Therapeutic and Complementary Nutrition (Modern Nutrition) (2016) Mary JM, Pamela W-M and Jennifer MB, CRC PRESS, Taylor and Francis Group ISBN: 084931612X, 9780849316128, 9781420003413.

SEMESTER-III

SEMESTER-III

Course title: Biostatistics and Bioinformatics

Credit: 4

Course code: SIAL SC 1 3 05 C 4004

Lectures: 60

Course objective: To introduce the students in the field of bioinformatics and enables them to understand the concepts of statistics in biology.

Learning outcomes:

- Understanding statistical analysis of biological data
- Understanding the role of computer science in predicting structure and function of biomolecules
- Understanding similarities and differences among living organisms on the basis of genetic information

Unit-I

Definition of selected terms scale of measurements related to statistics; Methods of collecting data, Presentation of data statistical Tables, Need for reduction of data measures of averages and location, Measures of dispersion: Range, quartile deviation, mean deviation and relative deviation. Probability: basic concepts; basic theorems of probability addition and multiplication theorems; conditional probability of Bayes Theorems. Probability mass function, probability density function, cumulative distribution function.

Unit-II

Probability distribution definition and applications; Binominal distribution, Poisson distribution, Normal distribution, logic of statistical standard error estimation testing of hypothesis. Tests of significance: Null hypothesis, alternative hypothesis, type I error, type II error, level of significance, and power of test. Tests for mean based on normal distribution, one sample t-test, two-sample t-test, paired-sample t-test, Chi-Squared test, and Tests for variance based on normal distribution – one sample and two-sample problem. One-way and Two-way analysis of variance (ANOVA) techniques. Correlation concept and applications, Spearman's rank correlation coefficient, regression concept and applications.

Unit-III

Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches), Applications of bioinformatics. Introduction to biological databases - primary, secondary and composite databases, Different formats of molecular biology data. NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB)

Unit-IV

Similarity, identity and homology. Alignment-local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTAL omega. Identification of open reading frames (ORF), Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis, maximum parsimony, maximum likelihood and distance methods; creation, evaluation and interpretation of evolutionary trees phylogenetic tree.

Suggested Readings:

1. Fundamentals of Statistics (2016) Goon, AM, Gupta, MK and Dasgupta, B. Vol. I & II. World Press, ASIN: B01LB7MH74.
2. Statistical Methods (2012) 1st ed., Das, NG. Vol I & II. Tata McGraw Hill, ISBN: 9780070263512.

3. Probability and Statistics for Engineers and Scientists (2013) 9th ed., Walpole, RE, Myers, RH, Myers, SL and Ye, Pearson Education India KE ISBN: 978-9332519084
4. Biostatistics: A Foundation. for Analysis in the Health Sciences (2012) 10th ed., Daniel, WW and Cross, CL. John Wiley & Sons, ISBN: 978-1118302798
5. Essential Bioinformatics (2006) 1st ed., Xiong J, Cambridge University Press, ISBN 13: 978-0521600828.
6. Fundamental concepts of Bioinformatics (2003) Krane DE and Raymer ML Pearson, ISBN: 978-8177587579.
7. An Introduction to Bioinformatics (2017) 1st ed., Knight R, Larsen and Keller Education, ISBN: 978-1635490459.
8. Concepts of Bioinformatics and Genomics (2016) 1st ed., Momand J, McCardy A, Heubah, S and Warter-Perez N, Oxford University Press, ISBN: 978-0199936991

SEMESTER-III

Course title: Food Microbiology and Food Safety

Credit: 4

Course code: SIAL NB 1 3 04 C 4004

Lectures: 60

Course objective: The major learning objectives of this course will be to study the scope of food microbiology and food safety and to gain the essential knowledge and applications of various techniques (traditional to advanced) for preserving food.

Learning outcomes:

- Understanding techniques (traditional to advanced) for preserving food
- Understanding the role of microorganisms in food spoilage, food fermentation and foodborne diseases
- Understanding microbiological quality control and foodborne illnesses investigation procedures for ensuring food safety and hygiene
- Understanding the requirements and components of food safety management system (FSMS) and practical applications of microbiological risk assessment (MRA) tools for assessing microbiological risks in the food sector

Unit-I

Introduction to food microbiology and food safety; Microflora of food; Intrinsic and extrinsic factors affecting microbial growth and survival in food; Microbiological examination of food; Advances in isolation and enumeration of microorganisms in food; Principles of food preservation and significance; Preservation of food by physical methods – low, high temperatures, radiation; Preservation of food by chemical methods; Bio preservation of food.

Unit-II

Modified environment for storage of food; fermentative microorganisms as food and value-added product, single and mixed fermentation- lactic, yeast-lactic, mold-lactic fermentation in food; starter cultures for food fermentation; fermented milk, milk products, juices, vegetables and other beverages; fermented meat and fish products.

Unit-III

Food spoilage: causes and solutions; spoilage of fruits, vegetables, and their products; spoilage of dairy products, canned food, bakery and egg products, meat, fish, and seafood; newer methods for controlling spoilage of food; predictive modelling for food spoilage; food-borne outbreaks- bacterial agents for food-borne illnesses; fungal and algal agents for food-borne illnesses; food-borne animal parasites.

Unit-IV

Investigation of food-borne illnesses outbreaks; indicators of food microbial quality and safety; principles and applications of hurdle technology in food industry; principles of hygiene and sanitation in food service establishment; food safety laws; food safety and quality management system; principles and guidelines for conducting microbiological risk of food.

Suggested readings:

1. Food Microbiology (2016) 4th edition Adams M R, Moss M O and McClure P, Publisher: Royal Society of Chemistry, ISBN: 9781782627623
2. Food Microbiology (2013) 5th edition Frazier W C and Westhoff D C, Publisher: Mc Graw Hill India, ISBN: 978-1259062513

3. Modern food microbiology (2005), 7th edition, Jay J M, Loessner M J and Golden D A, Publisher: Springer US, DOI: 10.1007/b100840, eBook ISBN 978-0-387-23413-7.
4. Food Microbiology: An Introduction (2017) 4th edition Karl R Matthews K R, Montville T J, Kniel K E, Washington, DC : ASM Press, ISBN: 9781523112579.
5. Prescott's Microbiology (2017) 10th edition, Willey J, Sherwood L and Woolverton J C, Publisher: McGraw Hill Education, ISBN: 9781259281594

SEMESTER-III

Course title: Nutritional Requirements, Deficiencies and Assessment

Credit: 4

Course code: SIAL NB 1 3 05 C 4004

Lectures: 60

Course objective: To introduce the students in the field of nutrition and enable them to understand about major nutritional deficiency diseases, their assessment and what are the nutritional requirements for different vulnerable group.

Learning outcomes:

- Comprehensive knowledge of methodology and derivation of nutrients requirements
- Acquiring the information about nutritional considerations changes with age and physiological group
- Understanding aetiology and preventive measures for various deficiency diseases
- Gaining knowledge about various methods for improving the quality of diets

Unit-I

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, indian dietary guidelines.

Unit-II

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. Overview of national and international policies related to nutrition, nutrition surveillance and monitoring.

Unit-III

Physiological changes and altered nutritional requirements in extreme temperatures - low and high, high altitude, space nutrition and food systems. Protein energy malnutrition, nutritional anaemia, vitamin A deficiency, iodine deficiency disorders, vitamin D deficiency: aetiology and pathogenesis, clinical manifestations and biochemical changes. Anthropometric measurements – indices and reference standards Biochemical parameters and clinical examination.

Unit-IV

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-Nutri-genomics, nutraceuticals, functional foods and bioactive compounds. National and International agencies in uplifting the nutritional status – World Health Organization (WHO), The United Nations Children's Fund (UNICEF), CARE, Indian council of Medical Research (ICMR), Indian council of Agriculture Research (ICAR), Council of Scientific and Industrial Research (CSIR), Central Food Technological Research Institute (CFTRI). Various nutrition related welfare programmes, Integrated Child Development Services (ICDS), School Lunch Programme (SLP) and others.

Suggested readings:

1. *Aware Food Choices: Bridging the Gap Between Consumer Knowledge About Nutritional Requirements and Nutritional Information* [1 ed. 2016]., Angela Tarabella, Barbara Burchi (auth.), Springer Briefs in Food, Health, and Nutrition., Springer International Publishing, ISBN: 978-3-319-23855-5, 978-3-319-23856-2
2. *Nutrition: A Lifecycle Approach.* (2015) 2nd ed., Chadha R and Mathur P. Orient Blackswan, New Delhi. ISBN-10: 812505930X
3. *Nutrient Requirements and Recommended Dietary Allowances for Indians.* (2016).ICMR, National Institute of Nutrition, Hyderabad.
4. SHARMA AL. Textbook of Human Nutrition. *Med J Armed Forces India.* 1998 Jan;54(1):87. doi: 10.1016/S0377-1237(17)30431-8. Epub 2017 Jun 26. PubMed Central PMCID: PMC5531320.
5. *Handbook of Nutritional Requirements in a Functional Context - Volume II, Hematopoiesis, Metabolic Function, and Resistance to Physical Stress* [First edition] by Rechcigl, Miloslav, CRC Press, ISBN: 978-1-315-89385-3

SEMESTER-III

Course title: Nutrition in Metabolic Disorders

Course code: SIAL NB 1 3 06 C 4004

Credit: 4

Lectures: 60

Course objective: To understand the concepts of different diseases and role of diet in the management of disease.

Learning outcomes:

- Understanding importance of nutritional assessment in the care of patients
- Understanding metabolic changes in various diseases/disorders and the associated principles of diet therapy
- Comprehend the rationale of prevention of various diseases/disorders

Unit-I

Concept, purpose and principles of diet therapy, basic concepts and methods of - (a) oral feeding (b) tube feeding (c) parental nutrition (d) intravenous feeding, etio-pathophysiology, metabolic and clinical aberrations, diagnosis, complication, treatment, dietary management and recent advances in obesity, overweight and underweight, Diabetes Mellitus – Type 1, Type 2, Diet in Diabetes mellitus: Incidence and predisposing factors, symptoms-types and tests for detection. Metabolism in diabetes dietary treatment & meal management hypoglycaemic agent, insulin and its types. Complication of diabetes.

Unit-II

Diet in surgical conditions and burns. Gout- Nature and occurrence of uric acid, causes, symptoms and diet. Diet in allergy and skin disturbances: Definition, classification, manifestations, common food allergies and dietetic treatment, incidence of Atherosclerosis, dietary principles, hyperlipidaemia, hypertension- causes and dietary treatment, etio-pathophysiology, metabolic and clinical aberrations, diagnosis, complication, treatment, dietary management and recent advances in cardio vascular diseases.

Unit-III

Diet in fever and infections- Types- metabolism in fever, general dietary consideration. Diet in gastritis, peptic ulcer- symptoms, clinical findings, treatment, chemically and mechanically irrigating foods, four stage diet (Liquid, soft, convalescent, liberalized diet). Overview of Nutrition in gastrointestinal disorders, nutrition in diseases of liver, nutrition in food allergy and intolerance.

Unit-IV

Diet in renal diseases: basic renal function, symptoms and dietary treatment in acute and chronic glomerulonephritis, nephrosis, renal failure, dialysis. urinary calculi-causes & treatment. diet in disturbances of small intestine and colon. aetiology, symptoms and dietary treatment in - jaundice, hepatitis, cirrhosis and hepatic encephalopathy. aetiology and dietary management in cancer, effect of cancer therapy on nutritional status, factors affecting carcinogenesis process

Suggested readings:

1. Krause's Food & the Nutrition Care Process, (2017) 14th Edition L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CD., Sylvia Escott-Stump., Saunders Elsevier. ISBN: 9780323340755

2. Clinical Nutrition (The Nutrition Society Textbook). (2011). Michael J. Gibney, Marinos Elia, Ljungqvist O and Dowsett J. Blackwell Science., UK ISBN: 0632056266
3. Modern Nutrition in Health and Disease. (2012) 11th ed., Shils ME, Shike M, Ross A.C., Caballero B and Cousins R.J. Lipincott, William and Wilkins. ISBN-10: 1605474614
4. Farrell Metabolic Diseases: Foundations of Clinical Management, Genetics, and Pathology. (2017) 2nd Edition. E. Gilbert-Barness, L.A. Barness, P.M. IOS Press. ISBN: 978-1-61499-717-7
5. Nutrition Management of Inherited Metabolic Diseases: Lessons from Metabolic University. (2015). Laurie E. Bernstein, Fran Rohr, Joanna R. Helm Springer International Publishing. DOI: 10.1007/978-3-319-14621-8 ISBN 978-3-319-14621-8

SEMESTER-III

Course title: Practical-III

Course code: SIAL NB 1 3 07 C 0084

Credit: 4

1. Isolation and characterization of microorganisms of food origin.
2. Microbiological analysis of water, milk, fruit juices, and street foods.
3. Assessment of Surface sanitation by Swab and Rinse method.
4. Detection of common adulterants in food.
5. Determination of proximate composition of food samples.
6. Determination of mineral contents in the food sample.
7. Assessment of Anthropometry Measurements.
8. Assessment of clinical signs of Nutrient deficiency.
9. Diet plans for Athletes, Wrestler, Badminton Plyer, Cricketer and Chess Player.
10. Diet plan to weight loss and weight gain.
11. Estimation of Serum cholesterol.
12. Planning of Diet
 - a) Fever and infections
 - b) Diabetes mellitus
 - c) CVD's
 - d) Renal diseases
 - e) Gout

Suggested readings:

1. A manual of laboratory techniques. (2003) 2nd edition. Raghuramulu N, Nair MK and Kalyansundaram S (eds). National Institute of Nutrition, ICMR.
2. Cappuccino J G. Microbiology: A Laboratory Manual, 12th edition Pearson (2019)
3. The Microbiology of Safe Food (2010).2nd edition, Forsythe,S.J., Willey-Blackwell,U.K., ISBN: 978-1-405-14005-8
4. The Food Safety Hazard Guidebook, (2012) 2nd edition, Lawley, R., Curtis L. and Davis, J. Royal Society Of Chemistry publishing, Cambridge, United Kingdom ISBN: 101849733813
5. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education limited.

SEMESTER - III

Course title: Seminar

Course code: SIAL NB 1 3 08 C 0202

Credit: 2

Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members/student advisors well in advance so that the same may be displayed on the notice board. The presenter has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.

SEMESTER-III

Course title: Food Biotechnology
Course code: SIAL NB 1 3 04 DCEC 4004

Credit: 4
Lectures: 60

Course objective: The major learning objectives of this course will be to develop the understanding of biotechnology applications in relation to food.

- Understand food fermentation for improved nutrition
- Understand novel food additives and supplements
- Understand mechanism and process of food spoilage and its preservation
- Understand monitoring of food quality and packaging of food

Unit-I

Introduction: microorganisms in food-historical developments, food fermentation Technology: origin, scope and development of fermented products, primary feed stock, raw materials and conversions, fermented food and microbial starters, commercial potential, food fermentation industries, their magnitude, R&D innovations.

Unit-II

Development of novel food and food Ingredients: Single cell protein, polysaccharides, low calorie sweeteners, naturally produced flavor modifiers, amino acids, vitamins, food supplements, food coloring, nutraceuticals, water binding agents. Bioreactors in food fermentations: Cultivation of microorganisms, instrumentation regulation and process control, laboratory scale submerged and solid state fermentation, pilot scale submerged and solid state fermentation.

Unit-III

Food spoilage and preservation: general principle of spoilage, microbial toxins (endotoxins and exotoxins), contamination and preservation, factors affecting spoilage. Methods of food preservation (thermal processing, cold preservation, chemical preservatives & food dehydration); Role of radiations in food preservation, characteristics of radiation of interest in food preservation. Principles underlying the destruction of microorganisms by irradiation. Effect of irradiations on food constituents. Legal status of food irradiation.

Unit-IV

Biological controls and monitoring of food quality, packaging of food: Need for packaging, requirements for packaging, containers for packaging (glass, metal, plastics, molded pulp and aluminium foil), dispensing devices.

Suggested readings:

1. Introduction to Food Biotechnology., (2002), Perry Johnson-Green. Publisher; CRC Press. USA; ISBN 9780849311529
2. Modern Food Microbiology 7th Ed. (2006)., Jay, James M., Loessner, Martin J., Golden, David A., Springer, ISBN 978-0-387-23413-7
3. Food microbiology: fundamentals and frontiers (2013) 4th edition. Buchanan, Robert, 1946- & Doyle, Michael P & American Society for Microbiology ASM Press, Washington, DC, ISBN: 1555816266

4. Biotechnological Strategies in Agro-processing. (2003)., 2nd ed., Marwaha S.S & Arora, J.K. Asia tech Publishers, New Delhi. ISBN-10: 8187680091
5. Biotechnology in Agriculture and Food Processing: Opportunities and Challenges (2013) 1st edition, Parmjit S. Panesar, Satwinder S. Marwaha., CRC Press ISBN:1439888361, 9781439888360

SEMESTER-III

Course title: Nutrigenomics
Course code: SIAL NB 1 3 05 DCEC 4004

Credit: 4
Lectures: 60

Course objective: To understand the gene and nutrient interaction.

Learning outcomes:

- Understanding how diet and underlying genetics interaction increase susceptibility to disease.
- Comprehensive knowledge about the methods and strategies used to study complex trait, genetics and nutrition.
- Understanding how nutrients and other bioactive compounds can alter gene expression for improved disease outcome or prevention.
- Understanding how genetic modification of crops can be used to more effectively deliver drugs, vaccines, nutrients and bioactive substances.

Unit-I

Genomics and Applied Bioinformatics (DNA sequencing, DNA Sequence annotation, NCBI resources and other on-line databases, pairwise sequence alignment, blast and advances blast, multiple sequence alignment, evolutionary trees and molecular phylogenetic inference, gene expression), next generation sequencing platforms and role in nutrigenomics, genome sequencing and annotation, variant calling and analysis, clustering and pathways, protein structure, homology modelling.

Unit-II

Nutrient/diet gene interactions, bioactive food components, practical applications. Introduction to macromolecules (carbohydrates, proteins and nucleic acids); animal cells, simple and complex components of organelles, and tissues; important metabolic pathways and regulations (lipids, proteins and nucleic acids).

Unit-III

Introduction to various target validation models (cell-line models, zebrafish model and animal models), control of gene transcription and screening models. Single nucleotide polymorphism and associated metabolic aberrations, epigenetics, nutrigenomics and physiopathology of important non-communicable diseases (obesity, diabetes, cardiovascular diseases); nutrigenomics, genes and gene products which are important in these diseases, personalized nutrition and metabolic diseases. Metabolic effects of the dietary fibre and the modulation of gut microbiota. Body composition and energy assessment.

Unit-IV

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.

Suggested readings:

1. Qi L (2012). Gene-Diet Interactions in Complex Disease: Current Findings and Relevance for Public Health. *Current nutrition reports*, 1(4), 222–227. doi:10.1007/s13668-012-0029-8
2. Tucker, KL, Smith, CE., Lai, CQ, & Ordovas, JM (2013). Quantifying diet for nutrigenomic studies. *Annual review of nutrition*, 33, 349–371. doi:10.1146/annurev-nutr-072610-145203.
3. Tanaka, T, Ngwa, J S, van Rooij, FJ, Zillikens, MC, Wojczynski, MK, Frazier-Wood, AC Nettleton, JA (2013). Genome-wide meta-analysis of observational

studies shows common genetic variants associated with macronutrient intake. The American journal of clinical nutrition, 97(6), 1395–1402. doi:10.3945/ajcn.112.052183

4. Madden J, Williams CM, Calder PC, 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.
5. Institute of Medicine. 2007. Nutrigenomics and Beyond: Informing the Future: Workshop Summary. Washington, DC: The National Academies Press. <https://doi.org/10.17226/11845>.
6. Kaput, J., & Rodriguez, R. L. (2006). Nutritional Genomics: Discovering the Path to Personalized Nutrition. John Wiley & Sons, Inc. <https://doi.org/10.1002/0471781797>

SEMESTER-III

Course title: Sports Nutrition

Course code: SIAL NB 1 3 06 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To gain the knowledge and understanding of nutrition required for exercise and sport in order to enhance performance and to learn the role and significance of macro nutrients and micronutrients in achieving fitness.

Learning outcomes:

- Comprehensive knowledge about nutritional guidelines for athletes performing under altered climatic conditions.
- Understanding the importance and process of nutritional counselling for athletes.
- Gaining information about special nutritional concerns of travelling athlete and athletes with physical disabilities.

Unit-I

Nutritional guidelines and nutritional requirements for younger and older athletes, nutritional concerns of travelling and vegan athletes, athletes performing under altered climatic conditions- high altitude mountaineers, high and low climatic temperature, nutrition guidelines for athletes with physical disabilities.

Unit-II

Integrated approach to care for athletes, assessment of sports performance, bioenergetics and body metabolism of physical activity and sports, macro- and micro nutrients for sport performance temperature regulation, fluid balance, fluid requirements of athletes and rehydration strategies for sports.

Unit-III

Recommended allowances and nutritional guidelines for different categories of high-performance sports, nutritional care during training, weight management and day-to-day recovery, nutrition for the pre-competition, competition and post competition recovery phase, supplements in sport: performance enhancing substances, drugs, ergogenic aids and herbs in sports performance.

Unit-IV

Anaemia, osteoporosis, Diabetes Mellitus, hypertension and heart disease (physiology, effect of nutrition, age, sex and exercise on health, preventive and curative strategies), gastro intestinal disorders: peptic ulcer, gastroesophageal reflux disease (GERD), irritable bowel syndrome (IBS), etc., aetiology, pathophysiology and effect of exercise.

Suggested reading:

1. Integrated Periodization in Sports Training & Athletic Development: Combining Training Methodology, Sports Psychology, and Nutrition to Optimize Performance. (2018).1st edition., Tudor Bompa, Boris Blumstein, James Hoffman. Meyer & Meyer Sport, USA, ISBN: 1782551417
2. Essential Sports Nutrition: A Guide to Optimal Performance for Every Active Person. (2018)., Marni Sumbal. Callisto Media Incorporated. ISBN:1641521694
3. Clinical Sports Nutrition, (2006) 3rd edition Burke, L. Y. and Deaking, V. Tata McGraw HillPub. England. ISBN: 9780074716021
4. Sport Nutrition (2018) 3rd Edition. Jeukendrup, Asker, Gleeson, Michael, Human Kinetics. USA ISBN: 1492529036.

5. Nutritional Ergogenic aids, (2004) 1st Edition Wolinsky, Ira and Driskell, J. CRC Press NY. Management, Belmont (USA). Wadsworth/Thompson Learning. ISBN: 9780849316265

SEMESTER – III

Course title: Food Microbiology and Food Safety

Course code: SIAL NB 1 1 03 GEC 4004

Credit: 4

Lectures: 60

Course objective: The major learning objectives of this course will be to study the scope of food microbiology and food safety and to gain the essential knowledge and applications of various techniques (traditional to advanced) for preserving food.

Learning outcomes:

- Understanding techniques (traditional to advanced) for preserving food
- Understanding the role of microorganisms in food spoilage, food fermentation and foodborne diseases
- Understanding microbiological quality control and foodborne illnesses investigation procedures for ensuring food safety and hygiene
- Understanding the requirements and components of food safety management system (FSMS) and practical applications of microbiological risk assessment (MRA) tools for assessing microbiological risks in the food sector

Unit-I

Introduction to food microbiology and food safety; microflora of food; intrinsic and extrinsic factors affecting microbial growth and survival in food; microbiological examination of food; advances in isolation and enumeration of microorganisms in food; principles of food preservation and significance; preservation of food by physical methods – low, high temperatures, radiations; preservation of food by chemical methods; bio preservation of food.

Unit-II

Modified environment for storage of food; fermentative microorganisms as food and value-added product, lactic, yeast-lactic, mold-lactic fermentation in food; starter cultures for food fermentation; fermented milk, milk products, juice, vegetables and other beverages; fermented meat and fish products.

Unit-III

Food spoilage: causes and solutions; spoilage of fruits, vegetables, and their products; spoilage of dairy products, canned food, bakery and egg products, meat, fish, and sea food; newer methods for controlling spoilage of food; predictive modelling for food spoilage; foodborne outbreaks- bacterial agents for foodborne illnesses; fungal and algal agents for foodborne illnesses; foodborne animal parasites.

Unit-IV

Investigation of foodborne illnesses outbreaks; indicators of food microbial quality and safety; principles and applications of hurdle technology in food industry; principles of hygiene and sanitation in food service establishment; food safety laws; food safety and quality management system; principles and guidelines for conducting microbiological risk of food.

Suggested readings:

1. Food Microbiology, (2010) 4th edition, Adams M.R. and Moss M.O. New Age Food Microbiology, (2015) 4th edition, Adams M.R. and Moss M.O. New Age International (P) Limited Publishers, New Delhi, India. ISBN:978-1-84973-960-3
2. Food Microbiology. (2008) 4rd edition. Frazier W.C. and Westhoff D.C. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. ISBN: 9780070667181
3. Modern Food Microbiology, 4th edition, Jay J.M., CBS Publishers and Distributors, Delhi, India, 2009. (Part I) ISBN: 9788123904757

4. Modern food microbiology, (2011) 7th edition, Jay J.M., Loessner M.J. and Golden D.A., CBS Publishers and Distributors, Delhi, India. ISBN 978-0-387-23413-7
5. Microbiology. (2009) 7th edition, M.J., Chan, E.C.S and Krieg, N.R., Tata McGraw-Hill, New Delhi. ISBN: 0-9631172-1-1

SEMESTER – III

Course title: Human Nutritional Requirements

Course code: SIAL NB 1 1 04 GEC 4004

Credit: 4

Lectures: 60

Course objectives: The aim of this course is to provide knowledge on fundamental concepts nutritional requirements for different age groups and how nutrient requirement changes in different conditions.

Learning outcomes:

- Comprehensive knowledge about nutritional considerations changes with age and physiological group.
- Understanding of body composition changes through the lifecycle.
- Understanding the ways for improving nutritional quality of diets.

Unit -I

Historical perspective of nutrient requirements and definitions (recommended nutrient intakes, minimum requirements, subsistence requirements, dietary reference intakes, optimum nutrient intake), recommended dietary allowances of macronutrients for all age groups, food pyramid, dietary guidelines for indians, guidelines for physical activity (national and international).

Unit-II

Aspects of growth- cellular to physical, determinants of growth and development in children, 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

Physiological changes and altered nutritional requirements in: Extreme temperatures - low and high, high altitude, space nutrition and food systems and sports nutrition.

Unit-IV

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.

Suggested readings:

1. Nutrition: A Lifecycle Approach. (2015) 1st Edition., Chadha R and Mathur P., Orient Blackswan, New Delhi. ISBN: 812505930X
2. Nutrient Requirements & Recommended Dietary Allowances for Indians 2nd Edition - (2010) By B.S. Narasinga Rao, B. Sivakumar). ICMR, National Institute of Nutrition, Hyderabad., ASIN: B06XKXGF58
3. Textbook of Human Nutrition. (2009).,3rd Edition. Bamji M.S., Rao N.P., Reddy V. Eds Oxford and IBH publishing Co Pvt Ltd New Delhi, ISBN:81-204-1109-9
4. Nutrition in Developmental Transition. (2006)., NFI, NFI-WHO (SEARO) Symposium.?
5. Krause's Food and Nutrition care process. (2017) 14th L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CDSt. Louis, Missouri: Elsevier, USA., ISBN:9780323340755

SEMESTER-IV

Course title: Dissertation

Credit: 20

Course code: SIAL BT 1 4 01 SEEC 0020

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.
- The guidelines and format for dissertation is given below:

Dissertation Guidelines

1. GENERAL :

The manual is intended to provide broad guidelines to the M.Sc. candidates in the preparation of the dissertation report. In general, the project report shall report, in an organised and scholarly fashion an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known.

2. NUMBER OF COPIES TO BE SUBMITTED:

Students should submit three copies to the Head of the Department concerned on or before the specified date.

3. ARRANGEMENT OF CONTENTS OF DISSERTATION:

Dissertation material should be arranged as follows:

1. Cover Page & Title page
2. Declaration
3. Certificate
4. Abstract (Hindi and English)
5. Acknowledgements
6. Table of Contents
7. List of Tables
8. List of Figures
9. List of Symbols, Abbreviations and Nomenclature (Optional)
10. Chapters
11. References
12. Appendices
13. One page CV

The Tables and Figures shall be introduced in the appropriate places.

4. PAGE DIMENSIONS AND MARGIN:

The dimensions of the dissertations should be standard A4 size paper may be used for preparing the copies, **standard margin** with 1.5 line spacing.

5. MANUSCRIPT PREPARATION:

The general text of thesis shall be typed in font style Times New Roman and font size 12. Same quality of paper should be used for the preparation of the entire report/thesis; except figure, photos are shown.

5.1 Cover Page & Title Page - A specimen copy of the Cover page & Title page for report/thesis are given in Annexure I.

5.2 Certificate-The Bonafide Certificate as per the format shown in Annexure II

5.3 Abstract: Abstract should be an essay type (HINDI and ENGLISH) of narration not exceeding 500 words outlining the research problem, the methodology used for tackling it and a summary of the findings, typed in 1.5line spacing.

5.4 Acknowledgements: The acknowledgements shall be brief and should not exceed one page. The student's signature shall be made at the right bottom above his / her name typed in capitals.

5.5 Table of contents - The table of contents should list all material following it as well as any material which precedes it. The title page, Bonafide Certificate and Acknowledgment will not find a place among the items listed in the Table of Contents but the page numbers in lower case Roman letters are to be accounted for them. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents for report / thesis is given in Annexure III.

5.6 List of Table - The list should use exactly the same captions as they appear above the tables in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head.

5.7 List of Figures - The list should use exactly the same captions as they appear below the figures in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head

5.8 List of Symbols, Abbreviations and Nomenclature - One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations etc. should be used.

5.9 Chapters - The chapters may include

Chapter I – Introduction

Chapter II - Literature Review

Chapter III –Materials and Methods

Chapter IV- Results and Discussion

5.10 Research output/outcome if any published or presented in conference/seminar/symposium may be included.

5.11 List of References - Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the report/thesis. The citation may assume any one of the following forms. **APA Style.**

APA in-text citation style uses the author's last name and the year of publication, for example: (Field, 2005).

Example:

Derwing, T. M., Rossiter, M. J., & Munro, M. J. (2002). Teaching native speakers to listen to foreign-accented speech. *Journal of Multilingual and Multicultural Development*, 23(4), 245-259.

Thomas, H. K. (2004). *Training strategies for improving listeners' comprehension of foreign-accented speech* (Doctoral dissertation). University of Colorado, Boulder.

6. TYPING INSTRUCTIONS

6.1 General

This section includes additional information for final typing of the thesis. Some information given earlier under 'Manuscript preparation' shall also be referred. The impressions on the typed/duplicated/printed copies should be black in colour. Corrections, interlineations and crossing out of letters or words will not be permitted in any of the copies of the report/thesis intended for submission. Erasures, if made, should be neatly carried out in all copies. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12.

Single spacing should be used for typing:

- (i) Long Tables
- (ii) Long quotations
- (iii) Foot notes
- (iv) Multilane captions
- (v) References

6.2 Chapters The format for typing chapter headings, division headings and sub division headings shall be same as given in Table of Contents.

7. BINDING SPECIFICATIONS

Thesis should be spiral or soft cover book bound, the cover of thesis should be of dark greencolor, printed with golden ink and the text for printing should be identical as prescribed for the title page.

APPENDIX I A:(A typical Specimen of Cover Page & Title Page–DISSERTATION)

TITLE OF DISSERTATION

<1.5 line spacing>

DISSERTATION

Submitted by

<Italic>

NAME OF THE CANDIDATE

Under the Supervision of

NAME OF THE SUPERVISOR

in partial fulfillment for the award of the degree of

<1.5 line spacing>

MASTER OF SCIENCE IN

NAME OF THE PROGRAMME

DEPARTMENT OF

SCHOOL OF

CENTRAL UNIVERSITY OF HARYANA,

MAHENDERGARH-HARYANA

<1.5 line spacing>

MONTH AND YEAR

DECLARATION

I, student of the School of Interdisciplinary and Life Sciences, Central University of Haryana, Mahendergarh hereby declare and certify with my signature that my thesis entitled

..... submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science is a record of original research work done by me and the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University. I have faithfully and accurately cited all my sources, including books, journals, handouts and unpublished manuscripts, as well as any other media, such as the Internet, letters or significant personal communications.

I understand the concept of “plagiarism” and declare that while drafting this dissertation I have refrained from plagiarism. I know that plagiarism not only includes direct copying, but also the extensive use of other’s ideas without proper referencing or acknowledgement (which includes the proper use of references and quotation marks).

If my dissertation found to be plagiarized at any point of time, I’ll be solely responsible and will be ready to accept any decision taken by the competent authority including rejection of my dissertation.

(Supervisor)

(Signature of student)

APPENDIX – I B: (A typical Specimen of Certificate)

For example -

(A typical Specimen of Table of Contents)

TABLE OF CONTENTS

| CHAPTER NO. | TITLE | PAGE NO. |
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| | LIST OF TABLES | xvi |
| | LIST OF FIGURES | xviii |
| | LIST OF SYMBOLS, ABBREVIATIONS | xxvii |
| 1 | INTRODUCTION | 1 |
| | 1.1 GENERAL | 1 |
| | 1.2 NEED FOR THE STUDY | 2 |
| | 1.3 OBJECTIVES OF THE STUDY | 3 |
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| | 2.2.1 Product | 6 |
| | 2.2.2 Product.... | 6 |

ANNEXURE II

Curriculum vitae

Personal Details

Name :

Date of birth : DD Month, YYYY

Place of birth :

Nationality : Indian

Permanent Address :

Email Id :

Mobile No. :

Education

M.Sc. (Subject) : YYYY Central University of Haryana, India

B.Sc. (Subject). : YYYY (Name of the University) with % of marks

Higher Secondary : YYYY (Name of the board) with % of marks

Secondary : YYYY, (Name of the board) with % of marks