ST ALOYSIUS COLLEGE, MANGALURU

(AUTONOMOUS)

Re-accredited by NAAC "A" Grade

Course Structure and Syllabus

M.Sc. FOOD SCIENCE, NUTRITION & DIETETICS

Learning Outcomes - Based Curriculum Framework for

Postgraduate Food Science, Nutrition and Dietetics

(2021-22 onwards)

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Re-accredited by NAAC with 'A' Grade - CGPA 3.62
Recognised by UGC as "College with Potential for Excellence"
College with 'STAR STATUS' conferred by DBT, Government of India
3rd Rank in "Swacch Campus" Scheme, by MHRD, Govt of India

Date: 16-02-2021

NOTIFICATION

Sub: Syllabus of **M.Sc. Food Science, Nutrition and Dietetics** under Choice Based Credit Scheme.

Ref: 1. Decision of the Academic Council meeting held on 12-12-2020 vide Agenda No: 6(2021-22)
2. Office Notification dated 16-02-2021

Pursuant to the above, the Syllabus of **M.Sc. Food Science, Nutrition and Dietetics** under Choice Based Credit Scheme which was approved by the Academic Council at its meeting held on 12-12-2020 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL

ST. ALOYSIUS COLLEGE MANGALURU 575 003 (AUTONOMOUS)

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library
4. PG Office

Preamble

Food Science, Nutrition and Dietetics have tremendously been growing as one of the most sort-out subject owing to its multi-faceted significance in areas of healthcare, industry and most of all its applicability in our day to day life. Knowledge on diet, nutrition and its application can help one prevent the onset of diseases especially the one related to lifestyle such as obesity, diabetes and certain risk factors for cancer and Heart disease. The focal point of the subject is on the association of nutrients to human physiological functions. However, the subject not only revolves around understanding the contribution of each nutrient towards health and disease at individual levels but also involves the prime interpretation of nutritional status information and food compositional information for a better understanding of its contribution towards the public health sector. This will in turn help in better policy making to uplift the double burden of malnutrition.

In view of the above aforementioned importance, the course was designed to include concepts of human physiology, nutritional biochemistry, human nutrition, clinical nutrition, the chemistry of food as well as public health nutrition. Familiarizing the students with the used of newer technologies and methods involving community studies, sustainable use of resources for human nutrition, planning effective diets and evaluation of nutritional status both at individual and community level are the hallmark of the course in Food science, Nutrition and Dietetics. The syllabus is framed with utmost care to ensure that students learn the integrated relationship between science of food, the society and technology in order to enhance the quality of human life and internalize the principle of giving back to the society from which they draw, in a much sustainable manner. The students will gain themselves employment in research organizations, food industries, food agricultural sector, dietetic practice in health care centers, education and child development domains, strategic planning in nutrition education and policy making.

To achieve such goals the course objectives had been ensured to help students embark themselves not only on theoretical knowledge of the concern subjects but also practical knowledge through extensive training and research, capacity building of individuals for social and economic empowerment. Higher education learning in the subjects of Food Science, Nutrition and Dietetic provides students the opportunity to sharpen their capacities with a sense

of scientific and social responsibility. The course also focuses on improving interpersonal skills among students by regularly conducting class seminars, workshop, short projects, student faculty interaction programmes and student community programmes.

1. Introduction

The Food Science, Nutrition and Dietetic Post graduate program categorise itself both under health science and community science multi-disciplinary field of study. Our country and the entire globe has been facing the multifaceted problem of malnutrition in all its form. Half of the population suffers from hunger and another half is overweight/ obese with accompanied micronutrient deficiencies. Keeping in mind the current scenario, the Learning Outcomes-based Curriculum Framework (LOCF) for M.Sc. Food Science, Nutrition and Dietetics has been designed to integrate the application of health and nutritional sciences both at individual and community level with scientific knowledge that correlates food and nutrition towards nutrition, health and food security. The coursework will aim at molding students into eminent group of food scientists and nutritionist who are capable of improving the quality of life of individuals, family, community and nation as a whole. The Food science, Nutrition and Dietetics is a program which is predominantly practical oriented involving the students in community surveys, hospital case studies, food compositional analysis and hosting of nutrition education programs thus helping them to develop and enhance various skills contributable towards innovation, incubation and entrepreneurship, professional as well as employable skills. Encouragement on research-oriented learning through Project work/internship/fieldwork is a key component of the program in order to help students build capabilities and competencies for conducting primary research. The curriculum has been structured to prepare the postgraduates to achieve advanced skills and confidently step out to overcome the problems of nutrition and health as well as uplifting food insecurities among individuals or the society/community/nation. Hence, students would be involve in multidimensional advance learning of core competence and applicable base subjects of various disciplines with principle attributes such as disciplinary knowledge, laboratory/field and research oriented practical, the skill of writing and publishing, communication and presentation skills, self-learning and literature review, critical thinking, analytical and problem solving abilities, use of computer and statistical analytical tools, team learning, leadership qualities, multicultural competencies, visionary abilities, professional

commitment and most importantly obliging with the Sustainable Development Goals (SDGs) of United Nations in order to contribute to the overall growth and development of the country.

The model curriculum offered, has a multidisciplinary approach visualizing the New Education Policy of 2020 while also helping individual learners achieve the Sustainable Development Goals through their knowledge and skillful contributions as future Professionals.

2. Learning Outcomes based approach to Curriculum planning

2.1. Nature and extent of PG program in Food Science, Nutrition and Dietetics:

The PG programs in Food Science, Nutrition and Dietetics is build on the fundamentals of Human Nutrition but keeping in mind the advancement in the way of teaching to disseminate among student's up-to-date knowledge and the recent advancements in the field. The nature of a Post graduate study is to compulsorily focus on the learning outcomes-based approach. Hence, the curriculum planning and development will have to ensure that degree is awarded on the basis of demonstrated achievement of outcomes in terms of knowledge, understanding skills, applicability, attitudes, employability and values. It is the learning outcome that will define the capability of a learner to know, understand and apply his/ her accumulated knowledge and skills at the professional level. Ideally, the Postgraduate education in Food Science, Nutrition and Dietetics should aim to help learners achieve an in depth understanding of the advancement in the field of Nutrition and Dietetics by sufficiently incorporating content of topics at advance level in areas such as human / clinical nutrition, nutritional biochemistry, diet therapy and public health nutrition. It is also utmost important that the syllabus covering these areas include practical and research-oriented skills, which correlates well with the theoretical learning outcomes. In conclusion, the structured course should be immensely perceptible to the learner for predisposing scientific thinking among that would lead to new innovations and discoveries in the field.

The overall objectives of the learning outcomes-based curriculum framework are to:

- Help mold scientific attributes, qualification and designation descriptors and course learning outcomes.

- Enable potential students, parents, employers and others understand the knowledge, skills, attitude and values or principle attributes that the learner achieved and is capable of demonstrating or applying it professionally after the successful completion of the course.
- Update the advancement in areas concerning the course in order to be comparable and match to the international learning outcomes for academic excellence among learners.
- Monitor and evaluate the learning and teaching tools and assessment methods that were developed from time to time. This can be achieved by comparing them to standards set by eminent higher education institutions at both national and international levels.

2.2. Aims of Post Graduate Program in Food Science, Nutrition and Dietetics

The aims and objectives of our Post Graduate Educational Program in Food Science, Nutrition and Dietetics is designed to:

- Invent a platform conducive enough for students to learn and imbibe themselves with core understanding and research skills on fundamental advancement of the principles and concepts in Food Science, Nutrition and Dietetics.
- Develop outcome base learning by facilitating practical learning of the subject through experiments and research performed in designated laboratories or through field studies and correlating data acquired with theoretical knowledge.
- Develop applicable based learning competency among the learners by encouraging them to solve case studies related to subject domains.
- Impart and developed professional skills among the learners
- To foster professional research and development and also specialized them to imbibe professional competencies in teaching as well as government and public service and entrepreneurship.

3. Post Graduate Attributes in Food Science, Nutrition and Dietetics

The Post graduate attributes reflect the particular principle characteristics of an individual, including the knowledge, skills, attitudes, values, research temperament, and application-based competencies along with logical and analytical reasoning skills that are expected to be acquired by a post graduate of MSc. Food Science, Nutrition and Dietetics. The Postgraduate attributes for the students pursuing Food Science, Nutrition and Dietetics Program include outcome

capabilities that help strengthen them to move ahead in gaining advance knowledge and skills in the specific areas of Nutrition and Dietetics viz. Human Physiology and Nutrition, Clinical Nutrition and Diet Therapy, Nutritional Biochemistry, Nutraceuticals and Functional Foods, Public Health Nutrition, Food Chemistry and Food Microbiology, undertaking future research to bring solutions to food and nutritional related problems at individual, family and community levels and also performing professionally well in careers related to the concern discipline and domains.

Post Graduate attributes are channeled through meaningful and skillful learning experiences made possible through the updated curriculum, the primary research experiences, and a process of critical and reflective thinking. Therefore, the characteristics attributes of postgraduates of Food Science, Nutrition and Dietetics Program include:

i. **Disciplinary Knowledge and Skills -** Capable in demonstrating advance theoretical and practical knowledge as well as research competencies and in depth understanding in subjects like:

- **Human Physiology and Nutrition** involving the studies of physiological function of the human body and correlating it with studies on macro and micronutrients and their physiological and biochemical contribution to human health and the development of diseases.
- **Clinical Nutrition and Diet Therapy** that include nutrition care process and dietary intervention studies for different physiological and disease condition, diet counseling skills.
- **Nutritional Biochemistry** involving the science behind the metabolic role of nutrients in the human body and the biochemical processes that involves xenobiotics, enzymes and drugs with established interacting relationship with nutrients.
- **Food Chemistry and Food Microbiology** which deals with food compositional analysis both chemically and microbiologically. It also includes the study of the behavioral attributes of food components while undergoing processing and storage.
- **Nutraceuticals and Functional Foods** entailing studies of disease preventing factors of foods or its components like the phytochemical present in foods.

- **Public Health Nutrition** which will engage the students in understanding the role of nutrition and its contribution towards public health and nutritional status of communities or vulnerable groups.

ii. **Effective Communicator:** Ability to communicate precisely, confidently and with clarity while counseling hospital clients or during community studies involving the rural and urban population. Learners should be able to effectively use dietary counseling skills like empathy, reflective reasoning and listening, as well as the use of extension education tools to create nutritional awareness and uplifting nutritional status of special communities .Competency to express thoughts and ideas through dietitian-client centered role plays and case study presentations, diet counseling and presentation through one day workshops or seminars, publication and writing skills.

iii. **Critical thinking, Analytical reasoning and Problem solving:** Competent to utilize critical thinking in order to identify the problem related areas and resolving it using efficient analytical skills and capabilities.

iv. **Research and Scientific reasoning:** Ability of conducting translational researches by way of Case Studies, Field or community Surveys based on nutritional status or dietary pattern, food compositional analysis/ nutrient characterization, nutrient retention and stability studies, nutrient bioavailability studies and functional food product development and other related topics in order to identify the problems of the related domains and arrive at the data based on the scientific reasoning wherever applicable.

v. **Cooperation/ Team Work and Leadership readiness/ qualities:** Capability of working efficiently with diverse teams within the study premise or for case studies within healthcare or community premises. Students should also be able to co-ordinate well among a team for organizing departmental or college related events and functions. Ability to lead a team into doing productive work by evaluating and guiding to practice and acquire the required insight on leadership attributes.

vi. **Reflective thinking:** To have empathy is one hallmark characteristic of every dietitian or nutritionist. Hence, students should be well competent to practice the art of reflective listening by understanding and putting themselves into the other's person situation and objectively provide the clients or the community with a plausible solution to the problem presented.

vii. **Digital Literacy:** Competency in reviewing relevant and genuine information and data documented in original articles from Electronic media with a motive to learn, understand and use it for formulating translational research on the domains of Food Science, Nutrition and Dietetics. Expectancy in application of basic computer as well as statistical tools for well presentable data analysis will be worth of recognition and publication.

viii. **Self-directive learning:** Potential to complete the assigned projects either in classroom, laboratory or home successfully on time, by managing the resources independently and wisely.

ix. **Multicultural competence:** Ability to learn about different food habits and cultures by way of traditional food preparation, research on indigenous communities and foods, observing the influence of culture and religion on food habits, food availability and security. Competent enough to work with other fellow students or population hailing from different cultures.

x. **Moral and Ethical awareness/reasoning:** Imbibing a sense of moral responsibility and values to refrain from unethical practices such as false data mining, plagiarism, fabrication, falsification, misinterpretation of the data, breaching intellectual property rights, adopting unbiased and truthful actions to make efforts of acquiring sustainable development for all.

xi. **Lifelong Learning:** Up to date principles, theories, concepts and methods on the subject domain by consistently reading, reviewing and researching about upcoming specializations/ fields, technological advancement through self-directed learning with a motive to achieve economic, social, cultural and personal sustainable developmental goals.

4. **Qualification Descriptors**

A qualification descriptor of Food Science, Nutrition and Dietetics postgraduate program requires a standard outcomes, academic excellence and postgraduate attributes for its award. All the attributes mentioned are expected to be attained and demonstrated with excellent skills and stipulated as outputs after successfully completing the course. These descriptors form the standard indicators for the qualification and help the degree-awarding bodies in designing, approving, assessing and reviewing academic programs. The learning experiences and assessment procedures are expected to be designed to

provide every student with the opportunity to achieve the intended program learning outcomes that should reflect disciplinary knowledge, professional skills and understanding of the subject and its domains. And also, to include broad skills, and global competencies, that all students in different academic fields of study should imbibe, acquire, accumulate, apply and disseminate. The students who will complete two years of full–time study of postgraduate program in Food Science, Nutrition and Dietetics will be awarded a Master Degree. Some of the expected learning outcomes that a student should be able to demonstrate on completion of the Master level program include the following:

- Demonstrate (i) a rational knowledge and understanding of the course program and its applications, and links to related disciplinary areas/subjects of study; including a critical understanding and application of the advance theories, principles and concepts and methods (ii) Knowledge and hands on skills that could mold into professionals in the diverse areas of Nutritional Science, including research and development, teaching and government and public services; (iii) updated developments in the academic field of Nutritional Science, including a critical understanding of the latest developments in the area of specialization, and an ability to use established techniques of analysis and curiosity within the area of specialization.
- Demonstrate comprehensive knowledge about materials, including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to Food Science, Nutrition and Dietetics, and techniques and skills required for identifying related problems and issues.
- Demonstrate skills in quantitative and qualitative data mining to analyzed and interpret them using methodologies as appropriate to the subject in order to formulate translatory research as a solution to existing nutritional problems.
- Accurately disseminating knowledge by communicating or publishing the results of studies undertaken in the academic field during the course.
- Addressing one’s own learning abilities relating upcoming and advance areas of the subject and its domains, making use of research data that would help in professional growth

- Apply one's punitive knowledge and understanding relating to Nutritional science and translating it in ways that would answer the hypothesis being questioned.
- Demonstrate subject-related and translational skills that are pivotal to achieving job and employment opportunities in the field of Nutritional Science.

5. **Programme Learning Outcomes related to MSc. Food Science, Nutrition and Dietetics**

Food Science, Nutrition and Dietetics is a science-oriented, multidisciplinary subject which encompasses the multifaceted activities that occur in at individual, healthcare, households, and community levels. The course is both multidisciplinary and interdisciplinary in its context encompassing the five major disciplines of Human Nutrition, Clinical and therapeutic Nutrition, Nutrition in Critical Care and Emergencies, Diet therapy and Public Health Nutrition. Each discipline has one or more specific areas of specialization. The term 'programme' refers to the entire scheme of study that would lead learners to a qualification which would essentially comprise a combination of the aforementioned disciplines. Offering the Programme as a value-laden master level course, the learners competencies needs to be reflected in The Programme Outcomes (PO) and the Programme Specific Outcomes (PSO).

Programme Outcome (PO) statements (M.Sc. Food Science, Nutrition and Dietetics)

i. Deliver quality tertiary education through learning theoretically and practically
ii. Reflect universal and domain-specific principle and values in Nutritional Sciences and its concerned domains.
iii. Involve, communicate and engage key stakeholders.
iv. Learn, disseminate knowledge and apply skills gained for a beneficial change from time to time.
v. Imbibe the ability to address the complexities and interface related to nutrition at all levels.
vi. Generate multi-skilled professionals with a holistic perspective has core competencies across all disciplines of Nutritional Sciences.

vii. Instill both fundamental and research-specific skills, innovation and design to succeed in the employment market as well as proposing for governmental and non-governmental funded research.

viii. Foster a genre of responsible students with a passion for lifelong learning and entrepreneurship.

ix. Develop sensitivity, resourcefulness and competence to render sustainable developmental goals which are nutritional oriented for individuals, families, communities, and the nation at large.

x. Enhance digital literacy and apply them to engage in real time hypothetical solving of problems related to all fields of Nutritional Science.

Programme Specific Outcomes – PSO: On completion of the MSc. programme in Food Science, Nutrition and Dietetics the outcomes expected from students are

(a) Describe and analyze the discipline of Nutritional Science as a holistic field of study covering multiple facets and requirements of human beings in day to day living, for example, achievement of a good nutritional status, overcoming degenerative and lifestyle diseases through dietary interventions, restoring public and community health through surveys and nutrition education based on nutritional prophylaxis programs and strategies for community extension and communication., appropriate milestones in interpersonal development such as communicating and writing skill

(b) Demonstrate skills/talents and proficiency in specialized areas of study

(c) Demonstrate efficient networking in diverse areas of the course involving significant stakeholders including professionals, researchers, and public service personnel

(d) Address nutritional concern for the community (urban, rural and tribal) with genuine sharing and dissemination of knowledge and research findings for the benefit of the community

(e) Manifest a wide range of knowledge regarding sources of information collection and transfer enabling the exchange of ideas and notions; access to resources including e-resources and libraries; trends in knowledge gaining and transfer (teaching- learning processes); techniques of skill acquisition and understanding existing basic issues related to the disciplines in Nutritional Science and methods to rectify them

(f) Demonstrate interest in engaging in active need based, innovative and community-oriented.
(g) Demonstrate inclination toward acquiring knowledge and doing in-depth studies on allied subjects of Food Science, Nutrition and Dietetics
(h) Explore and decide upon viable avenues of self-employment, research and entrepreneurship plus career options in different facets of Nutritional Science disciplines.

Programme Learning Outcomes

Hard Core courses

S. No.		PH 811.1	PH 812.1	PH 813.1	PH 814.1P	PH 815.1P	PH 811.2	PH 812.2	PH 813.2P	PH 814.2P	PH 811.3	PH 812.3	PH 813.3P	PH 814.3P	PH 811.4	PH 812.4	PH 813.4	PH 814.4P
1.	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.	Application of basic Food Science and Technology concepts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.	Linkages with related disciplines	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.	Procedural knowledge for professional subjects	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.	Skills in related field of specialization	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.	Develop investigative Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7.	Develop Technical Communication skills	-	-	-	X	X	-	X	X	X	-	-	-	X	X	-	-	X
8.	Developing analytical skills and popular communication	-	-	-	-	-	-	-	-	_	_	-	-	X	-	-	-	X
9.	Developing ICT skills	-	-	-	X	-	-	X	_	-	-	-	-	X	-	-	-	X
10.	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Soft core courses

S. No.		PS 816.1	PS 817.1	PS 818.1	PS 815.2	PS 816.2	PS 817.2	PS 815.4	PS 816.4	PS 817.4P
1.	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X
2.	Application of basic Food Science and Technology concepts	X	X	X	X	X	X	X	X	X
3.	Linkages with related disciplines	X	X	X	X	X	X	X	X	X
4.	Procedural knowledge for professional Subjects	X	X	X	X	X	X	X	X	X
5.	Skills in related field of specialization	X	X	X	X	X	X	X	X	X
6.	Develop investigative Skills	X	X	X	X	X	X	X	X	X
7.	Develop Technical Communication skills	-	-	-	X	-	-	-	-	X
8.	Developing analytical skills and popular Communication	-	-	-	-	-	-	-	-	X
9.	Developing ICT skills	-	-	-	X	-	-	_	_	-
10.	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self-reading, etc.,	X	X	X	X	X	X	X	X	X

Open Electives

S. No.		PO 818.2	PO 815.3
1.	Fundamental understanding of the field	X	X
2.	Application of basic Food Science and Technology concepts	X	X
3.	Linkages with related disciplines	X	X
4.	Procedural knowledge for professional Subjects	X	X
5.	Skills in related field of specialization	X	X
6.	Develop investigative Skills	X	X
7.	Develop Technical Communication skills	X	X
8.	Developing analytical skills and popular Communication	X	X
9.	Developing ICT skills	X	X
10.	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self-reading, etc.,	X	X

Structure of Postgraduate programme in Food Science Nutrition and Dietetics

The M.Sc. Food Science Nutrition and Dietetics Programme shall comprise "Core" and "Open Elective" courses. The "Core" courses shall further consist of "Hard core" and "Soft core" courses. Hard core courses shall have 4 credits; soft core courses shall have 3 credits. A candidate has to choose between the two options (A) or (B) for soft core courses. Open electives shall have 3 credits. Total credit for the programme shall be 92 including open electives.

Core courses are related to the discipline of the M. Sc Food Science Nutrition and Dietetics pro-gramme. Hard core courses are compulsorily studied by a student as a core requirement to complete the programme of M.Sc. Food Science Nutrition and Dietetics. Soft core courses are electives but are related to the discipline of the programme. Two open elective courses of 3 credits each shall be offered in the II and III semesters by the department. Open elective will be chosen from an unrelated programme within the faculty.

Out of the total of 92 credits of the programme, the **hard core will make up 60-80% of** the total credits, **soft core 20-30%** while the **open electives will have a fixed 6 credits (3 credits x 2 courses**). Students have to take **minimum of 18 credits and maximum of 26 credits in any semester.**

One credit is equivalent to

(i) One hour of teaching per week,
(ii) Two or one hour per week of tutorial, and
(iii) Two hours or one and half hours of practical work/field work per week.
(iv) Open electives may have 3 hours of instruction for 3 credits

Project work is taken up in the **third and/or fourth semester** and open electives are taken in 2nd and 3rd semesters.

Theory courses

Topics in each theory course are equally distributed in four units for Hard core courses and three units for soft core courses as well as for open electives.

Lab Courses

1. **Food Chemistry and Principles of Food Processing & Preservation:** A practical course that deals with the study of composition of foods and the chemical and physical behavioral characteristic or properties of foods and their components when subjected to

processing and preservation is prescribe for the first semester. The course / experiments are designed in such a way that students are able to correlate well to the theoretical knowledge and are able to imbibe advance experimental skills that would be useful for research and professional purpose.

2. **Human Physiology, Clinical Nutrition and Dietetics:** The first semester also included practical course on Human physiology and Human Nutrition to help learners understand the intricacies of the human metabolism and to comprehend the role of various nutrients in our body. To take this understanding to a translational intervention of providing dietary advices and plan for combating nutritional related diseases, the course on clinical nutrition and dietetics in the third semester was structured to be implemented in a way that students develop the skills of understanding various diseases, the etiology and skillfully provide dietary intervention for the same. These skills are an absolute need for one to be successful in working with health care providers or centers.
3. **Comprehensive approach to food microbiology, food safety, nutraceuticals / functional foods and nutritional biochemistry:** The last two semesters are equipped with practical courses that will help learners to understand the role of microbes in food as well as their contribution to shelf life stability of foods. In addition, an extensive practical course that study the functional properties of food components towards disease prevention and the role of food components in altering the biochemical functions in the human body will also be dealt with during the last two semesters. This will enable students to augment the theoretical knowledge with experimental skills carved within these domains of Nutritional Science.
4. **Community Nutrition:** Field studies dealing with nutritional and health status of certain community, vulnerable groups or population is always a hallmark of any course in Nutritional sciences. Hence, utmost thought has been taken to include practical studies dealing with skill enhancement in nutritional and dietary assessment of communities. This will help learners to be able to use standard indicators for interpretation of nutritional status of a specific group which is a fundamental skill for becoming a public health nutritionist or to work with the government in various nutritional prophylaxis programs of the country.

Project

There shall be a project in the Third semester. Evaluation of the project is done by two examiners (one external and one internal). The project will be evaluated for 100 marks out of which 70 marks is assigned for re-port/dissertation and the remaining 30 marks for internal assessment.

Seminars

A module of seminars has been included in the curriculum to improve presentation skills of the students. Each student has to give one seminar in a semester. The topics for the seminars will be assigned and will be guided.

Credit Distribution for M.Sc. Food Science Nutrition and Dietetics

Sl. No.	Nature of Papers	Total No. of Papers	Credit in Theory	Credit in Practical	Total Credits
1.	Core Course	10	40	-	40
2.	Discipline Specific Elective	06	18	08	26
3.	Generic Elective/Interdisciplinary	02	06	-	06
4.	Ability Enhancement Course	01	-	04	04
5.	Skill Enhancement Course	05	-	16	16
6.	MOOCs	00	-	-	00
7.	**Total**	**24**			**92**

Paper Distribution for M.Sc. Food Science Nutrition and Dietetics

Semester	Compulsory Hard-Core Courses (HC) each with 04 credits (Total no. of Courses 10)	Soft core courses (SC) each with 03 credits. (Total no. of Courses 05)	Open Elective courses for students of other discipline/programme of 03 credits each	Compulsory Skill Enhancement Course (SEC) 08 credits in each semester	Total Credits
Sem I	PH 811.1 PH 812.1 PH 813.1	PS 816.1 PS 817.1	-	PH 814.1P PH 815.1P	**26**
Sem II	PH 811.2 PH 812.2	PS 815.2 PS 816.2	PO 818.2	PH 813.2P PH 814.2P	**25**
Sem III	PH 811.3 PH 812.3	-	PO 815.3	PH 813.3 P PH 814.3 P	**19**
Sem IV	PH 811.4 PH 812.4 PH 813.4	PS 815.4	-	PH 814.4 P PS 817.4 P	**22**
Total Credits	**40**	**15**	**06**	**31**	**92**

Detailed Course Contents

I Semester					
Code	**Title**	**Lecture/Lab**	**Tutorial**	**Nature**	**Credits**
PH 811.1	Food Chemistry	**4**	**1**	**HC**	**4**
PH 812.1	Principles of Food Processing & Preservation	**4**	**1**	**HC**	**4**
PH 813.1	Human Nutrition	**4**	**1**	**HC**	**4**
PH 814.1P	**Practical:** Food Chemistry & Principles of Food Processing and Preservation	**8**		**HC**	**4**
PH 815.1P	**Practical:** Human Nutrition & Human Physiology	**8**		**HC**	**4**
PS 816.1	Human Physiology	**3**	**1**	**SC**	**3**
PS 817.1	Essentials of Micro Nutrients	**3**	**1**	**SC**	**3**
PS 818.1	Food Product Development				
II Semester					
PH 811.2	Clinical and Therapeutic Nutrition	**4**	**1**	**HC**	4
PH 812.2	Dietetics	**4**	**1**	**HC**	4
PH 813.2P	**Practical:** Clinical and Therapeutic Nutrition & Nutrition Through Life Cycle	**8**		**HC**	4
PH 814.2P	**Practical:** Dietetics	**8**		**HC**	4
PS 815.2	Research Methodology and Ethics	**3**	**1**	**SC**	3
PS 816.2	Nutrition Through Life Cycle	**3**	**1**	**SC**	3
PS 817.2	Nutrition and Physical Fitness				
PO 818.2	Basic Nutrition	**3**	**1**		3
III Semester					
PH 811.3	Food Microbiology	**4**	**1**	**HC**	4
PH 812.3	Nutraceuticals and Functional Foods in Human Health	**4**	**1**	**HC**	4
PH 813.3P	**Practical:** Food Microbiology & Nutraceuticals and Functional Foods in Human Health	**8**		**HC**	4
PH 814.3P	**Practical:** Project Work / Internship	**8**		**HC**	4
P0 815.3	Health and Fitness	**3**	**1**	**SC**	3
IV Semester					
PH 811.4	Nutritional Biochemistry	**4**	**1**	**HC**	4
PH 812.4	Community Nutrition	**4**	**1**	**HC**	4
PH 813.4	Sports Nutrition	**4**	**1**	**HC**	4
PH 814.4P	**Practical:** Nutritional Biochemistry & Food Safety and Quality Control	**8**		**HC**	4
PS 815.4	Food Safety and Quality Control	**4**	**1**	**SC**	3
PS 816.4	Assessment of Nutritional status				
PS 817.4P	**Practical:** Community Nutrition	**8**		**SC**	3

I Semester

PH 811.1 **Food Chemistry** **52 Hours**

Course Learning Objectives:

- To study the relationships between the structure and functional properties of food molecules
- To study chemical processes and interactions of all biological and non-biological components of food
- To understand physico-chemical parameters in food

Unit I

Food chemistry: Definition, scope and importance. Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam. Proximate analysis.

Unit II

Carbohydrates: Definition and importance, classification, sources, functions, physico-chemical Properties of carbohydrates, Cellulose, Guar and Locust Bean Gum, Xanthan, Carrageenan's, Algins, Pectins, Gum Arabica and Dietary fiber. Starch (functionality of starch – gelatinization and retro gradation), Modified starches, resistant starches; Browning reaction in food: Enzymatic and non-enzymatic browning and applications in food.

Unit III

Lipids: Chemical Classification; Properties: Physical and chemical; Lipolysis, rancidity (hydrolytic rancidity, oxidative rancidity and microbial rancidity) and flavour reversion, auto-oxidation, modification of fats and oils (hydrogenation and inter esterification, winterization and acetylation); transfats; nutritional aspects of natural and modified lipids; fat substitutes. Chemistry of fats and oils.

Unit IV

Amino acids and Proteins: Definition and importance, classification, sources, functions. Super secondary structure, physical, chemical and functional properties of food proteins, texturized protein, denaturation of protein, gel formation, modification of food protein in processing and storage and its implications. Digestibility coefficient, biological value, net protein utilization (NPU), protein efficiency ratio (PER).

Unit V

Minor food constituents: Sources, properties and cofactors; Theory of Enzyme catalysis, Kinetics of Enzyme catalyzed reaction, Enzyme utilization in food industries. Minerals, vitamins, flavours and anti-nutritional compounds. Changes in vitamins and minerals during storage and processing.

Broad contents of the course:

- Water soluble interaction,
- Water activity
- Dispersed systems
- Transfats
- Lipolysis
- Texturized protein
- Digestibility coefficient
- Carbohydrates
- Denaturation

Course learning outcome:

- Know the chemistry underlying the properties and reactions of various food components
- Have sufficient knowledge of food chemistry to control reactions in foods.
- Know the major chemical reactions that limit shelf life of foods.
- Use the laboratory techniques common to basic and applied food chemistry.
- Know the principles behind analytical techniques associated with food.

Recommended Books:

1. H. D. Belitz and W. Grosch (2013) Food Chemistry Edition 2, Publisher: Springer Science & Business Media (ISBN 3662072815, 9783662072813)
2. Richard Owusu-Apenten (2004) Introduction to Food Chemistry. Publisher: CRC Press (ISBN 084931724X, 9780849317248)
3. John M. deMan (2013) Principles of Food Chemistry Edition 3, Publisher Springer Science Business Media (ISBN1461463904, 9781461463900)
4. Fennema OR (2017) Food Chemistry 5th Edition edited by Srinivasan Damodaran, Kirk L. Parkin. Publisher: CRC Press (ISBN 9781482208122)
5. Konstantinos N. Papadopoulos (2008) Food Chemistry Research Developments, Nova Publishers, (ISBN1604562625, 9781604562620)

6. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.
7. Coultate, T. P. (2009). Food: the chemistry of its components. Royal Society of Chemistry.
8. Friberg, S., Sjoblom, J., & Larsson, K. (2003). Food emulsions. CRC Press.
9. Whitaker, J. R. (2018). Principles of enzymology for the food sciences. Routledge.
10. Akoh, C. C. (2017). Food lipids: chemistry, nutrition, and biotechnology. CRC press.

PH 812.1 Principles of Food Processing and Preservation 52 Hours

Course Learning Objectives:

- To understand the source and variability of raw food material and their impact on food processing operations.
- To understand the physical, chemical and biological processes involved in conversion of raw materials into finished food products.
- To study the principles and current practices of different processing techniques and its effects on process parameters and product quality.
- To study the spoilage and deterioration mechanisms in foods and its preventive measures.

Unit I

Scope and importance of food processing; Historical developments in food processing; Factors affecting various food spoilage: Physical, Chemical, Microbial & miscellaneous. Heat preservation and processing: UHT and HTST. Thermal death time: Determination of process time. Types of heat treatments and its effects on foods; Canning: Introduction, principles and processing of foods. Packaging materials designed for processed foods.

Unit II

Water activity: Role of water activity in food preservation; Intermediate Moisture Foods (IMF): Principles, Characteristics, advantages and problems of IM foods. Food Frying: Principles and process: shallow frying, deep frying and frying oils. Mechanism of Oil uptake during frying: Factors affecting the frying process. Food preservation: Types, uses and effects of class I and class II preservatives in foods. Conventional preservation methods: Pickling, Salting, Smoking and Sugar addition.

Unit III

Dehydration and Concentration: Drying, Drying curves, Different drying methods and type of dryers; Separation and concentration of food components. Different types of evaporators and ultra-filtration; Difference between dehydration and concentration; Changes during dehydration and concentration in foods. Rehydration and reconstitution of food.

Unit IV

Refrigeration: Principles, components, refrigeration load and storage; Changes in foods during refrigeration. Freezing: Freezing curves, slow and quick freezing, freezing methods, factors determining

freezing rate, frozen storage, changes in food during freezing. Chilling: Equipment, Cold storage, Application in fresh and processed foods.

Unit V

Green Technologies for Food Processing: Super critical fluid extraction & Ultrasound treatment, High pressure processing (HPP), Pulse electrical field (PEF), Ohmic heating, Microwave processing, Food irradiation (x-rays, gamma rays and electron beam), Interaction of radiation with food components, Principles and applications of Hurdle technology.

Broad contents of the course:

- Thermal death time
- Intermediate Moisture Foods
- Dehydration
- Concentration
- Refrigeration
- Evaporators
- Cold storage
- Food irradiation

Course learning outcome:

- Describe the source and variability of raw food material and their impact on food processing operations.
- Explain the spoilage and deterioration mechanisms in foods and methods to control deterioration and spoilage.
- Describe the unit operations required to produce a given food product.
- Explain the principles and current practices of processing techniques and the effects of processing parameters on product quality.

Recommended Books:

1. Smith, J. S., & Hui, Y. H. (Eds.). (2008). *Food processing: principles and applications*. John Wiley & Sons.
2. Kalia M. and Sangita, S. (1996).*Food Preservation and Processing*, First edition, Kalyani Publishers, New Delhi.
3. Sivasankar, B. (2002).*Food Processing and Preservation*, Prentice Hall of India Pvt. Ltd, New Delhi.
4. Khetarpaul N. (2005). *Food Processing and Preservation,* Dya Publishing House, New Delhi.
5. Fellows, P. J. (2009). *Food processing technology: principles and practice*. Elsevier.
6. Heldman, D.R., & Hartel, R. W. (1997). *Principles of food processing*.Springer Science & Business Media.

7. Barbosa-Cánovas, G.V., Tapia,M.S.,&Cano,M.P.(Eds.).(2004). *Novel food processing technologies*. CRC press.
8. Irudayaraj, J. M. (2001). *Food processing operations modeling: design and analysis*. CRC press.
9. Earle, R. L. (2013). *Unit operations in food processing*. Elsevier.
10. Ohlsson, T., & Bengtsson, N. (Eds.). (2002). *Minimal processing technologies in the food industries*. Elsevier.
11. Ramaswamy H and Marcott M. (2006). *Food Processing Principles and Applications.* CRC Press,

PH 813.1 **Human Nutrition** **52 Hours**

Course Learning Objectives:

- To understand the global perspective of nutrient requirements.
- To learn how to critically evaluate the methodology and derivation of requirements for specific macronutrients.
- To learn the metabolic functions of macronutrient and their role in health and disease
- To understand the implications of deficiency and toxicity of macronutrients and to assess their status in the body.
- To stay updated with emerging concepts in macronutrient science.

Unit - I

A Global Perspective on Food and Nutrition. Basis for computing nutrient requirements - latest concepts in dietary recommendation. Latest concepts in energy and protein requirements for Indians as defined by ICMR and WHO. Critical evaluation of sensitive methods and derivations of requirements and recommended dietary allowances of macronutrients for all age groups. The various methods use and their limitations.

Unit - II

Energy Metabolism: Definition and conceptualization of energy balance, Components of energy balance. Energy intake - sources of dietary energy, regulation of food intake, and factors influencing food intake. Energy expenditure and requirements - Concept of energy expenditure and requirements, components of energy expenditure and requirements (basal and resting metabolism their influencing factors, physical activity factor and thermic effect of foods) and determining methods (direct and indirect). Overview of energy balance in various conditions. Adaptation to altered energy intake – deficiency and toxicity.

Unit - III

Metabolism of Carbohydrates: Carbohydrates in foods. Digestive fate of dietary carbohydrates. Metabolic utilization of carbohydrate. Regulation of blood glucose concentration. Disorders related to carbohydrate metabolism - diabetes and its consequence, dietary management of blood glucose concentration (Glycemic index and glycemic load), non-glycemic carbohydrates, resistant starch, dietary fiber, intake of dietary fiber, oligosaccharides and other indigestible sugars (fermentation in the colon and the fate of short-chain fatty acids). Sugar alternatives. Lactose intolerance., dental caries.

Unit - IV

Metabolism of Lipids: The history of lipids in human nutrition. Terminology of dietary fats. Digestion, absorption, and transport of dietary fat (Reception, emulsification, lipolysis, solubilization, and absorption). Enterohepatic circulation (Re-esterification of triacylglycerols in the enterocyte, exogeneous and endogeneous transport pathway). Circulating lipids – lipoprotein structure and metabolism, LDL

transport and receptor pathways, HDL transport pathways. Role of dietary fats in health – PUFAs, MUFAs and short and medium chain triglycerides. Role of triglycerides and lipoprotein in the pathophysiology of disease (postprandial lipemia and artherosclerosis).

Unit - V

Metabolism of Proteins: Nutritional classification – indispensability and metabolic characteristic as the basis of classification. Concepts of essential and non-essential amino acids, their biochemical roles. Review of digestion, absorbtion, utilization and metabolism of protein (Catabolism and anabolism). Biology of protein and amino acid requirements - Body protein mass, concept of nitrogen balance and protein turnover. Estimation of protein and amino acid requirements - protein requirements for various age and physiological groups, determination of indispensable amino acid requirements, non-dietary factors affecting requirements. Protein nutritional quality - Amino acid scoring, PDCAAS, DIAAS. Protein malnutrition - Clinical features and biochemical changes.

Broad contents of the course:

- Energy balance
- Metabolism
- Blood glucose
- Glycemic index
- Dietary fats
- Triglycerides
- Dietary fiber
- Protein

Course learning outcome:

- The role of macronutrients in growth and development
- To evaluate the methodology and derivation of requirements for specific macronutrients.
- The metabolic functions of macronutrient and their role in health and disease
- The implications of deficiency and toxicity of macronutrients

Recommended Books:

1. Gibney, M.J., Lanham-New, S.A., Cassidy, A. and Vorster, H.H. (2009). Introduction to Human Nutrition, 2nd Edition. Wiley-Blackwell, A John Wiley and Sons, Ltd., Publication.
2. Berdanier, C. D., & Berdanier, L. A. (2015). *Advanced nutrition: macronutrients, micronutrients, and metabolism*. CRC press.
3. Mahan, K.S. and Escott-Stump, L. (2017). Krause's Food and the Nutrition Care Process. 14th Edition. Elsevier Publication.
4. Shils, M.E., Olson, J., Shike, M. and Roos, C (2003). Modern Nutrition in Health and Disease. 9th edition Williams and Williams. A Beverly Co. London.
5. Bodwell, C.E. and Erdman, J.W. (2008) Nutrient Interactions. Marcel Dekker Inc. New York
6. Sareen, S. and James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition. Thomson Wordsworth Publication, USA.

PS 816.1 **Human Physiology** **39 Hours**

Course Learning Objectives:

- To study the structure and function of a cell
- To understand the role, physiology and anatomy of all the systems in the body
- To learn the proper functioning of each systems and its related organelles

UNIT - I

Cell Structure and Function: Levels of cellular organization and function – organelles, tissues, organs and systems - Cell membrane transport across cell, membrane and intercellular communication. Regulation of cell multiplication.

UNIT - II

Digestive System: Review of structure and function - Secretory, Digestive and Absorptive functions - Role of liver, pancreas and gall bladder and their dysfunction - Motility and hormones of GIT. Regulation of food intake – role of hunger and satiety centers, effect of nutrients.

Respiratory System: Review of structure and function. Role of lungs in the exchange of gases. Transport of oxygen and Co_2. Role of haemoglobin and buffer systems. Cardio-respiratory response to exercise and physiological effects of training.

UNIT - III

Nervous System: Review of structure and function of neuron - conduction of nerve impulse, synapses and role of neurotransmitters - Organization of central and Peripheral nervous system. Hypothalamus and its role in various body functions - obesity, sleep and memory.

Endocrine System: Endocrine glands (Pituitary gland, Thyroid, parathyroid, Islets of Langerhans, Adrenals, Ovary and Testis, Thymus and Pineal gland – structure, function, role of hormones, regulation of hormonal secretion, Disorders of endocrine glands, Emphasis on physiology of stress hormones.

Exocrine System: Integumentary system. Structure and function of skin and maintenance of homeostasis.

UNIT - IV

Circulatory and Cardio Vascular System: Blood - formation, composition, clotting and haemostasis. Formation and function of plasma proteins. Erythropoesis, Blood groups and histocompatibility. Blood indices - Use of blood for investigation and diagnosis of specific disorders, Structure and function of heart and blood vessels - Regulation of cardiac output and blood pressure.

UNIT – V

Musculo-Skeletal System: Structure and function of bone, cartilage and connective tissue. Disorders of the skeletal system. Types of muscles structure and function.

Excretory system: Structure and function of nephron - Urine formation - Role of kidney in maintaining pH of blood -Water, electrolyte and acid base balance – diuretics.

Broad contents of the course:

- Cell
- Digestive system
- Respiratory system
- Endocrine
- Erythropoesis
- Blood group
- Nephron

Course learning outcome:

- Postgraduates should be able to understand the molecular biology of the cell.
- Students should be able to understand and recognize the role, physiology and anatomy of all the systems in the body.
- Students should be able to understand and acquaint with the diseases related to the malfunctioning of the organ systems.

Recommended Books:

1. Guyton, A.G. and Hall, J.B. (2005): Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.
2. Wilson, K.J.W and Waugh, A. (2003): Ross and Wilson Anatomy and Physiology in Heath and Illness 8th Edition, Churchill Livingstone.
3. Jain, A.K.: Textbook of Physiology. Vol.I and II. Avichal Publishing Co., New Delhi.
4. McArdle, W.D., Katch, F.I. and Katch V.L(2001): Exercise Physiology. Energy, Nutrition and Human Performance, 4th Edition, Williams and Wilkins, Baltimore.
5. Human Physiology: An Integrated Approach by Dee Unglaub Silverthorn
6. Human Physiology: From Cells to Systems by Lauralee Sherwood

PS 817.1 **Essentials of Micronutrients** **39 Hours**

Course Learning Objectives:

- To understand the balance of micronutrients in the body and their implications.
- To critically evaluate the principle of nutrition associated with metabolic pathways and function of each micronutrient.
- To learn and analyzed the interaction of micronutrients with other nutrients and drugs.
- To understand the implications of deficiency and toxicity of micronutrients and to assess their status in the body.

Unit I

Homeostasis Maintenance: Body fluids and water balance, distribution of water in the body, body water compartments; Regulation of water balance: Disorders of water balance. Electrolytes: Electrolyte content of fluid compartments, Role and function of Electrolytes like Sodium, Potassium and Chloride, their Absorption, Transport and balance; Factors affecting electrolyte balance and hydrogen ion balance.

Unit II

Fat Soluble Vitamins: Vitamins A, D, E and K - Source, Chemistry, Functions, Physiological action, Digestion, Absorption, Utilization, Transport, Storage, Excretion, RDA, Deficiency, Diagnosis of deficiency, Toxicity, Interaction with other nutrients and drugs.

Unit III

Water Soluble Vitamins: Thiamine, Riboflavin, B12, Folic acid, Pyridoxine, Pantothenic acid, Niacin, Biotin and Ascorbic acid - Source, Chemistry, Functions, Physiological action, Digestion, Absorption, Utilization, Transport, Storage, Excretion, RDA, Deficiency, Diagnosis of deficiency, Toxicity, Interaction with other nutrients and drugs.

Unit IV

Macro-minerals: Calcium - Sources, Distribution in the body, digestion, Absorption, Utilization , Transport, Excretion, Balance, Deficiency, Toxicity, RDA, Regulation of calcium concentration, Calcium interaction with other nutrients and drugs. Phosphorus - Source, Distribution, Concentration in the body, Digestion, Absorption, Utilization, Transport, Storage, Excretion. Calcium to Phosphorus ratio. Iron - Source, Distribution, Concentration in the body, Digestion, Absorption, Utilization, Transport, Storage, Excretion, RDA, interaction with other nutrients and drugs. Role of iron in prevention of anaemia. Diagnosis of deficiency of macrominerals.

Unit V

Micro-minerals: Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium - Sources, digestion, Absorption, Utilization, Transport, Excretion, Distribution, Physiological functions, deficiency, Toxicity and, diagnosis of deficiency.

Broad contents of the course:

- Body fluids
- Electrolytes
- Vitamins
- Minerals
- Absorption
- Deficiency
- Toxicity

Course learning outcome:

- To understand the intricacies of each micronutrients in growth and development of humans
- To understand the basis of human nutritional requirement and recommendations through the life cycle
- To analyze the nutrient – nutrient and nutrients – drug interaction. Students will be familiar with factors affecting for the absorption of nutrients
- To understand the implications of deficiency and toxicity of micronutrients and to assess their status in the body

Recommended Books:

1. Gropper, S. S., & Smith, J. L. (2012). Advanced nutrition and human metabolism. Cengage Learning.
2. Gibney, M.J., Lanham-New, S.A., Cassidy, A. and Vorster, H.H. (2009). Introduction to Human Nutrition, 2nd Edition. Wiley-Blackwell, A John Wiley and Sons, Ltd., Publication.
3. Berdanier, C. D., & Berdanier, L. A. (2015). Advanced nutrition: macronutrients, micronutrients, and metabolism. CRC press.
4. Combs Jr, G. F., & McClung, J. P. (2016). The vitamins: fundamental aspects in nutrition and health. Academic press.
5. Davidson, S. S., & Passmore, R. (1966). Human nutrition and Dietetics. E. & S. Livingstone.
6. Pike, R. L., & Brown, M. L. (1967). Nutrition: an integrated approach. Nutrition: an integrated approach.

PS 818.1 **Food Product Development** **39 Hours**

Objectives:

- To study the consumer food preferences and choices
- To enhance the knowledge base for product development
- To study the sensory evaluation of foods and to understand basics statistics

UNIT I

Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept New food product development (NPD) process and activities: NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness; use of novel food ingredients.

UNIT II

Standardization & large-scale production: Process design, equipment needed and Design; establishing process

parameters for optimum quality; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

UNIT III

Sensory evaluation of foods: Importance and application for product formulation. Sensory Evaluation; Lab requirements, Sensory panel, type, selection and training, Different types of sensory tests Instrumental tests for sensory attributes – colour, texture and odour. Electronic noses (e-noses) and electronic tongues (e-tongues): concept and applications.

UNIT IV

Quality, safety & regulatory aspects: Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.

UNIT V

Advertisement, Marketing & Case studies: Product performance testing; market positioning, Marketing:

developing test market strategies; various tools and methodologies to evaluate consumer attitudes, preferences and market acceptance factors; Case Studies of some successes and failures- Factors that influence NPD success, innovation case studies to highlight best practice in terms of the integration of technological and marketing approaches to NPD; food choice models and new product trends.

Recommended books:

1. Piggott, J.R. 2008: Sensory Analysis of Foods. Elsevier Applied Science, London.
2. Ranganna S. 2006. Hand Book of Analysis and Quality Control for Fruits and Vegetables Products 2nd Ed. Tata McGraw- Hill Publishing company Limited. New Delhi.
3. Srilakshmi, B., 2001, Food Science, New Age International Pvt. Ltd., ND.
4. Mahendru, S.N., 2000, Food Additives, Tata McGraw Hills, ND.
5. Manay, N.S., 2001, Foods: Facts & Principles, Wiley Eastern Ltd., ND.
6. Robertson, G.L. (2006). Food Packaging: Principles and Practice (2^{nd}), Taylor & Francis
7. Montgomery, D. C. (2007). Introduction to statistical quality control. John Wiley & Sons.
8. Clarke & Wright W., Managing New Product and Process Development. Free Press, 1999.
9. Earle R, Earle R & Anderson A, Food Product Development, Woodhead Publishing, 2001

Practicals

PH 814.1P: Lab 1: Food Chemistry & Principles of Food Processing and Preservation

PH 815.1 P: Lab 2: Human Nutrition & Human Physiology

II Semester

PH 811.2 **Clinical and Therapeutic Nutrition** **52 Hours**

Course Learning Objectives:

- To know the methods of nutrition assessment, derive at dietary guidelines and provide nutrition care
- To learn the aspects of nutritional counseling and its processes
- To understand the drug and nutrient interactions and toxicology
- To learn the advanced therapeutic nutrition care of enteral and parenteral nutrition

Unit I

Guidelines for Dietary Planning: Weights and Measures, Determining nutritional needs, Basic Guidelines for diet planning, Nutritional status of Indians, Cultural aspects of dietary planning. Nutritional assessment: Anthropometrics, Biochemical, Clinical and Dietary.

Unit II

Nutritional Care Process: Identification of high-risk patients - nutritional assessment, nutritional diagnosis, nutrition intervention, monitoring and evaluation of nutritional care. Assessment components - medical and nutritional care record, types and uses. Nutritional intervention and diet modification - diet prescription, Nutrition care for hospitalized patients - standard hospital diet and modifications of food intake.

Unit III

Nutrition Counseling: Nutritional counseling – concept, recipient and counseling environment, counseling methods. Activities for behaviour changes, intervention counseling models; types of counselling session in patients. Empowerment, interpersonal skills. Nutritional counseling components – planning, implementation and evaluation. Role of dietician on hospitalized and outdoor patients and development of nutritional care plan. Specific functions of a therapeutic, administrative and consultant dietician. Team approach in patient care. Psychological considerations in patient care. Inter personal relationship with patients.

Unit IV

Drug and Nutrient Interaction and Toxicology: Effect of Food on Drug Therapy. Effect of Drug on Food and Nutrition. Modification of Drug Action by Food and Nutrition. Effect of Drug on Nutritional Status. Diet in allergy - Common food allergens, test for allergy - Skin test and Elimination diet and Treatment for allergy. Diet related health disorders – food poisoning and intolerance, food allergy, alcohol and drug toxicity.

Unit V

Enteral and Parenteral Nutritional Support: Enteral nutrition, parenteral nutrition, Transitional feeding, Nutrition support in long-term and home care. Principle of Nutritional care, Types of hospital feeds. Nutrition Support Techniques, Enteral feeding - indications, Types - Nasogastric, Gastrostomy, Jejunostomy and Rectal feeding - requirements and advantages. Parenteral feeding - Nutritional Support, Formula feeds and Complications in Total Parenteral Nutrition. Complications of nutritional support systems including refeeding syndrome, palliative care, rehabilitation diets.

Broad contents of the course:

- Anthropometrics
- Diet planning
- Nutritional counseling
- Drug therapy
- Allergens
- Hospital feeds

Course learning outcome:

- Students will be able to intervene the metabolic anomalies of acute and chronic diseases
- They are able to demonstrate counselling techniques to facilitate behavior change
- They will get knowledge to plan menu for various diseases based on their nutritional status and dietary needs
- The students will know the importance of a dietician in hospitals.
- The students will be able to know the feeding therapy's to be flowed in hospitalized/ critically ill patients

Recommended Books:

1. Shills, M.E., Olson, J.A, Shike, M and Ross, A.C. (2002): Modern Nutrition in Health and Disease, 9th Edition, A. vaiiiams and Willdns..
2. Sareen, S, James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition, Thomson Wordsworth Publication, USA.
3. Chandra, R.K. (eds) (2002): Nutrition and Immunology, ARTS Biomedical. St. John's Newfoundland.
4. Krause's food and the nutrition care process, 14th edition (2017), L Kathleen Mahan and Janice Raymond.
5. Nutrition Counseling and Education Skill Development by Kathleen D Bauer, Doreen Liou

6. Nutrition Counseling Skills for Medical Nutrition Therapy by Linda G Snetselaar
7. Clinical Nutrition in Practice (2011) Editors: Charilaos Dimosthenopoulos, Meropi D. Kontogianni, Evangelia Manglara, Kalliopi-Anna Poulia. Publisher: John Wiley & Sons.
8. YK Joshi (2008) Basics of Clinical Nutrition. Edition2, Publisher: Jaypee Brothers, Medical Publishers Pvt. Limited.
9. Douglas C. Heimburger, Jamy D. Ard (2006) Handbook of Clinical Nutrition. Edition 4, illustrated. Publisher: Mosby/Elsevier.
10. Nutrition, Diet and Cancer (2012) Editors: Sharmila Shankar, Rakesh K. Srivastava. Publisher: Springer Science & Business Media.

PH 812.2 **Dietetics** **52 Hours**

Course Learning Objectives:

- To know the methods of assessing the critically ill patients
- To understand the treatment modalities in ICU
- To learn the pathophysiology and complications of various diseases and disorders
- To study the medical nutrition therapy for various diseases and disorders of the body

Unit I

Assessment of the critically ill: Nutritional screening and nutritional status. Preparation of nutritional care plan. Nutritional support systems. Monitoring nutrient intake and providing nutrition support service, role of immuno enhancers, conditionally essential nutrients, immune suppressants and special diets.

Unit II

Diet in Febrile condition: Fever, pneumonia and Tuberculosis. Medical nutrition therapy (pathophysiological, clinical and metabolic aspects) in the following conditions like burns, multiple organ failure and also other conditions of stress, trauma, sepsis and surgery. Nutritional problem in Natural/manmade disasters and communicable diseases: Famine, drought, flood, earthquake, cyclone and war.

Unit III

Diseases of cardio vascular system: Risk factors of CVD, Etiology, Symptoms and dietary management of atherosclerosis, Ischemic heart disease, dislipidemia, prevention through life style modifications. Hypertension: Classification, Prevalence, Diet related factors influencing hypertension and Management of hypertension. **Diseases of Renal system:** Etiology, Symptoms and Dietary modification in the following diseases like Nephritis, Nephrosis, Acute and chronic renal failure, Nephrolilthiasis, Transplantation and dialysis.

Unit IV

Diseases of Gastro Intestinal system: Disorders, Etiology, Symptoms and dietary management of Acute gastritis, Chronic gastritis, Peptic ulcer - duodenal & gastric, Intestinal disease - Flatulence, Diarrhoea and Dysentry, Constipation, Celiac disease, Tropical sprue, Irritable bowel syndrome, diverticular disease, Ulcerative colitis. **Liver**: Hepatitis, cirrhosis, Jaundice, fatty liver, cholecystits and cholelithiasis, Hepatic coma. **Pancreas:** Pancreatitis, Acute and chronic, Diabetes Mellitus - Etiology, Types, Symptoms, Diagnosis, metabolic alterations, complications and treatment.

Unit V

Diseases of Musculo-skeletal system: Rheumatoid arthritis, Osteoarthritis, Osteoporosis and Osteomalacia. **Genetic disorders** – Infections, AIDS and Inborn errors of metabolism. **Neurological disorders** - Parkinson's disease, Huntington's chorea, multiple sclerosis, myasthenia gravis, Alzheimer's disease, Wilson's disease and stroke. **Weight imbalances** - overweight and obesity, anorexia nervosa and Bulimia nervosa.

Broad contents of the course:

- Nutritional screening
- Immune enhancers
- Febrile condition
- Hypertension
- Dialysis
- Weight imbalances

Course learning outcome:

- Students will have the knowledge of pathophysiology and causes, symptoms, risk factors and dietary management of different disease conditions and disorders
- Students will have a thorough understanding the responsible of an dietician with respect to different disease
- The students will be able know nutrition support systems during emergency.
- Students able to understand principles of diet therapy, modification of normal diet for therapeutic purposes
- Students will be able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of individuals with medical conditions

Recommended Books:

1. Hypertension assorted topics, Hedge et al., (1995), Bharatiya Vidya Bhavan, Bombay.
2. Manual of Nutritional Therapeutics, 2nd edition, Alpers (1991), Little Brown Publications, Washington.
3. Krause's food and the nutrition care process, 14th edition (2017), L Kathleen Mahan and Janice Raymond.
4. Eleanor Schlenker, Sara Long Roth (2013) Williams' Essentials of Nutrition and Diet Therapy. Edition 10. Publisher: Elsevier Health Sciences.
5. Marcia Nelms, Kathryn P. Sucher, Karen Lacey, Sara Long Roth (2010) Nutrition Therapy and Pathophysiology. Edition 2. Publisher: Cengage Learning.
6. Nutrition in Clinical Practice: A Comprehensive, Evidence-Based Manual for the Practitioner (2012) Author: David L. Katz. Edition 2. Publisher: Lippincott Williams & Wilkins, 2012
7. Nutritional Considerations in the Intensive Care Unit: Science, Rationale and Practice (2002) Editors: Scott A. Shikora, American Society for Parental and Eternal Nutrition, Robert George Martindale. Publisher: Kendall Hunt.
8. Nutrition in the Prevention and Treatment of Disease (2017). Editors: Ann M. Coulston, Carol J. Boushey, Mario Ferruzzi, Linda Delahanty. Edition 4. Publisher: Academic Press.

9. Clinical Nutrition in Practice (2011) Editors: Charilaos Dimosthenopoulos, Meropi D. Kontogianni, Evangelia Manglara, Kalliopi-Anna Poulia. Publisher: John Wiley & Sons.
10. YK Joshi (2008) Basics of Clinical Nutrition. Edition2, Publisher: Jaypee Brothers, Medical Publishers Pvt. Limited.
11. Nutrition, Diet and Cancer (2012) Editors: Sharmila Shankar, Rakesh K. Srivastava. Publisher: Springer Science & Business Media.

PS 815.2 **Research Methodology and Ethics** **39 Hours**

Course Objectives:

- To understand the scientific approaches to research
- To understand the significance of research methods in food science
- To appreciate the importance of scientific writings and develop competence in writing skill
- To draft a research proposal and write a scientific paper

Unit I

Research: Types, objectives, research approaches, research and scientific methods, criterions of good research. Research Problem: Definition and techniques involve in defining a problem. Research Designs: Meaning, need for research design, features and types. Experimental Design: Basic principles of experimental design, selection of experimental material, Essential Constituents of Literature Review.

Unit II

Sampling: Need for sampling, unit, population and sample, sampling methods, Important Sampling Distributions, Central Limit Theorem and Sampling Theory. Sampling design: Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design. Data: Collection of Primary Data and Secondary Data. Classification and summarization of data. Presentation of Data - Diagrams and Graphs.

Unit III

Introduction to statistics: Measures of Central Tendency (Mean, Mode and Median); Measures of Central Dispersion (Range, Standard Deviation, Standard Error, Coefficient of Variation); Correlation-Regression-Simple, Multiple (three Variables). Tests of Significance–'t' Test (One Sample and Two Sample Tests), Hypothesis Testing, Level of Significance and Confidence Interval, Analysis of Variation (ANOVA). Multiple comparison test (DMRT), Chi square test for goodness of fit. Probability distributions. Application of computer in research: Basic principles of Statistical Computation using various softwares; design of experiments and analysis of results using various software (SPSS Statistics, Design Expert, etc).

Unit IV

Scientific/technical writing and research presentation: Types, Structure and components of Scientific Reports; Technical Reports and Thesis; Steps in the preparation of reports and thesis layout, structure and language of typical reports, illustrations and tables, bibliography, referencing and foot notes. Citation, Impact factor, h-index and Acknowledgement. **Ethics in research:** Responsible conduct; the regulations and ethics of animal use in research; Research ethics for human subjects; Role of ethics committees in biological research; **Intellectual Property Rights (IPR):** patenting of process and products; reproduction of published material; plagiarism.

Broad contents of the course:

1. Overview of Research
2. Scientific Thinking
3. Elements of Research
4. Quantitative Research Methods
5. Qualitative Research Methods
6. Presentation of Research
7. Ethics in research
8. Intellectual Property Rights (IPR)

Course learning outcome:

- Demonstrate knowledge of research processes (reading, evaluating, and developing)
- Perform literature reviews using print and online databases
- Define and develop a possible hied research interest area using specific research designs
- Compare and contrast quantitative and qualitative research paradigms, and explain the use of each in research
- Describe sampling methods, measurement scales and instruments, and appropriate uses of each
- Explain the rationale for research ethics, and the importance of IPR

Recommended Books:

1. Bandarkar, P.L. and Wilkinson T.S. (2000): Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai.
2. Copper, H.M. (2002). Intergrating research: A guide for literature reviews (2nd Edition). California: Sage Harman, E & Montages, I. (Eds.) (2007). The thesis and the book, New Delhi: Vistar.
3. Mukherjee, R. (1989): The Quality of Life: Valuation in School Research, Sage Publications, New Delhi.
4. Stranss, A and Corbin, J. (1990): Basis of Qualitative Research: Grounded Theory Procedures and Techniques, Sage Publications, California
5. Montgomery, D. C., (2001). Design and Analysis of experiments, Fifth Edition, John Wiley & Sons.
6. Kothari, C.R. (2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi
7. Vining, G. G., Kowalski, S. (2010). Statistical Methods for Engineers.2nd Edn. Cengage Learning (RS), Boston, USA.

PS 816.2 **Nutrition through Life Cycle** **39 Hours**

Course Learning Objectives:

- Describe how nutrition affects growth and development and the physiological basis of nutritional requirements throughout the life span.
- Identify eating patterns, nutritional problems and selected chronic diseases characteristic of age groups throughout the life span.
- Explain current issues in life span nutrition.

UNIT I

Nutrition during pregnancy and lactation:

Pregnancy: Physiological changes, nutritional requirements, optimal weight gain and its components, effect of malnutrition on outcome of pregnancy, complications of pregnancy.

Lactation: Physiology of lactation, factors affecting lactation, nutritional requirements, community nutrition and fertility.

UNIT II

Nutrition in Infancy: Growth and development during infancy, Immunization Schedule, Nutritional requirement and supplementation, Infant and young child feeding practices. Composition of different types of milk: Cow, buffalo, goat and reconstituted milk. Breast feeding and bottle feeding. Feeding of Low birth weight and premature infants; Human Milk Banks; weaning foods.

UNIT III

Nutrition during childhood: Preschool children: Growth and development, nutritional requirements, special care in feeding preschoolers, nutritional problems specific to this age. **School age and adolescent children:** Growth spurt, Role of hormones on growth, nutritional requirements, factors affecting their eating habits, nutritional problems specific to this age. Nutrition screening, assessment and counseling, nutritional concerns.

UNIT IV

Nutrition in the Adults and Elderly:

Young adults: Reference Man and Reference Woman, Adult consumption unit. Nutrient requirements, food choices and health habits, common nutritional problems. **Elderly:** Physiologic changes, Nutritional requirements, Special needs, Nutritional problems, Common diseases and disabilities affecting geriatric groups.

Broad contents of the course:

- Growth
- Development
- Pregnancy
- Lactation
- Infancy
- Supplementation
- Geriatric groups

Course learning outcome:

- Determine nutrient requirements/needs of individuals at different stages of life
- Discuss the major nutrition related concerns at each stage of life.
- Understand the nutritional needs during pregnancy and lactation, physiological changes and hormones involved during pregnancy and lactation
- Understand the effects of ageing and life expectancy

Recommended Books

1. Mahan, L.K. and Escott-Stump, S (2000) Krause's Food Nutrition and Diet-Therapy, 10thEdition, W-13 Saunders Ltd.
2. Khanna K, Gupta S, Seth R, Passi SJ, Mahna R, Puri S (2014) Textbook of Nutrition and Dietetics, 2nd Edition. Phoenix Publishing House Pvt. Ltd.
3. Wardlaw GM, Hampi JS, DiSilvestro RA (2004) Perspectives in Nutrition, 6th edition. McGraw Hill.
4. Chadha R., Mathur P. (eds). 2015. Nutrition: A Lifecycle Approach, Orient, New Delhi.
5. Seth V and Singh K., 2006. Diet Planning through the Life Cycle: Part 1 Normal Nutrition, a Practical Manual. Elite Publishing House Pvt. Ltd. New Delhi.
6. Mary Kay Mitchell (2015). Nutrition across the life span. MEDTECH, Scientific international Pvt Ltd.

PS 817.2 **Nutrition and Physical Fitness** **39 Hours**

Course Learning Objectives:

- To know the basics of health, nutrition and wellbeing
- To understand the concepts of diet and physical fitness
- To Emphasize the importance of proper fueling for physical activity, pre and post-workout
- To learn the special dietary modifications of sports nutrition

Unit -I

Basic Nutrition – Relation between foods and nutrition, Nutrients - Macro nutrients-their functions, food sources digestion, absorption deficiency symptoms and toxicity. Micro nutrients functions, food sources digestions and absorption, deficiency and toxicity. Non nutrient components of foods and their association to health. Fluid balance – Water compartments in human body, fluid regulation water intake in different conditions, dehydration and water intoxication. Recommended dietary allowances and balanced diet.

Unit - II

Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing. Gender and health. Nutritional status: Definition methods to assess nutritional status – (Relevant to maintenance of fitness), specific fitness and health.

Unit -III

Approaches to the management of fitness and health. Diet and exercise – Effect of specific nutrients on work performance and physical fitness. Fuel and other nutrients that support physical activity (metabolic pathways). Mobilization of fuel stores during exercise. Importance of carbohydrate loads. Nutrition, exercise, physical fitness and health – their inter relationship.

Unit -IV

Nutrition in sports – Sports specific requirements diet manipulation pregame and postgame means, Use of different nutragenic aids and commercial supplements. Sports drinks, Diets for persons with high energy requirements stress, fracture and injury.

Unit V

Significance of physical fitness and nutrition in prevention and management of weight control diabetes mellitus, CVD, bone health and cancer. Awareness about the alternative systems for health and fitness, like Ayurveda, yoga, meditation vegetarianism and traditional diets.

Broad contents of the course:

- Nutrients
- Balanced diet
- Fitness
- Health
- Diet
- Exercise
- Nutragenic aids

Recommended Books

1. Mahan, L.K. & Ecott-Stump, S. (2000): Krause's Food, Nutrition and Diet Therapy, 10th Edition, W.B. Saunders Ltd.
2. Sizer, F & Whitney, E. (2000): Nutrition – Concepts and Controversies, 8th Edition, Wadsworth Thomson Learning.
3. Whitney, E.N. & Rolfes, S.R. (2003): Understanding Nutrition, 8th Edition, West Wadsworth, An International Thomson Publishing Co.
4. Ira Wolinsky (Ed) (2003): Nutrition in Exercise and Sports, 3rd Edition, CRC Press
5. Parizkova, J. Nutrition, physical activity and health in early life, Ed. Wolinsky, I. CRC Pres

Open Elective

PO 818.2 **Basic Nutrition** **39 Hours**

Course Learning Objectives:

- To understand the basic concepts of food and nutrition.
- Enable to learn about basic food components
- To understand the weight management

Unit I

Food and Nutrients: Basic definitions, Physiological, Psychological & social functions of food, levels and assessment of nutritional status, changing concepts of nutrition. Recommended dietary allowances (RDA) & its uses, Food groups, Food guide, Balanced diet. Interrelationship between nutrition & health

Unit II

Carbohydrates: Sources, dietary importance, special functions of carbohydrates in body tissues, Disorders, relationship between dietary fiber and various health problems. **Fats:** Essential fatty acids (EFA), role of ω-3, ω-6 fatty acids in health and disease, trans fatty acid, prostaglandins, cholesterol, LDL and HDL and their health importance. **Proteins:** Sources, nature of amino acids and proteins, functions of protein, the concept of protein balance, Good quality protein.

Unit III

Vitamins: Sources, Types, requirements and functions; Deficiency and toxicity of Vitamins. **Minerals:** Sources, Types, requirements and functions; Deficiency and toxicity minerals. **Functional foods and Nutraceuticals:** Concept and categories of functional foods and their health importance. Types of nutraceutical compounds Dosage levels; adverse effects and toxicity of nutraceuticals, Difference between nutraceuticals and functional foods.

Unit IV

Energy: Energy content of foods, measurement of energy value of foods. Energy balance: Energy control in human metabolism, basal metabolic rate (BMR), factors affecting BMR, measuring of BMR, energy requirements and its estimation.

Nutrition and weight management: Obesity and its causes, body composition, Body Mass Index (BMI), Obesity related health issues. Glycemic Index (GI) of foods: Control and its importance, **Underweight:** Etiology, body composition, Body Mass Index (BMI), underweight related health issues.

Broad contents of the course:

- Food groups
- Dietary fiber
- Fatty acids
- Protein balance
- Energy
- Weight management
- Glycemic Index

Course learning outcome:

- Understand the functions and sources of nutrients, role of nutrients in maintenance of good health
- Understand the role of macro and micro nutrients in the growth and development
- Obtain the knowledge on role and importance of nutrition in weight management
- Gain knowledge about food pyramid, food guide, menu planning and balanced diet

Recommended Books:

1. Joshi, Nutrition & Dietetics, Tata McGraw-Hill Education Publisher, 3rd edition (2010)
2. Esther Winterfeldt, Margaret Bogle and Lea Ebro, Dietetics: Practice and Future Trends, Jones & Bartlett Learning (2010).
3. Begum, Textbook of Foods, Nutrition & Dietetics, Sterling Publishers Pvt. Ltd. (2008)
4. Anne Payne, Helen M. Barker Advancing Dietetics and Clinical Nutrition, Elsevier Health Sciences (2011).
5. Joan Webster-Gandy; Angela Madden; Michelle Holds worth Oxford Handbook of Nutrition and Dietetics, Oxford(2012)
6. Benjamin Caballero; Luiz Trugo; Paul M. Finglas Encyclopedia of Food Science and Nutrition, Academic Press, 2nd Edition (2003).
7. Vickie Vaclavik; Elizabeth W. Christian Essentials of Food Science, Springer Science & Business Media, 4th Edition (2013).
8. Insel, P; Turner R.E.; Ross, D. Discovering Nutrition, ADA, Jones and Bartlett Publishers Inc. USA, 2nd Edition (2006).
9. Gibney, M.J.; Elia, M., Ljungqvist, O.; Dowsett, J.; Clinical Nutrition, The Nutrition society text book series, Blackwell publishing company (2005).
10. Srilakshmi B; Dietetics, New Age International Publishers (2011).

Practicals

PH 813.2P: Lab 1: Clinical and Therapeutic Nutrition & Nutrition through Life Cycle

PH 814.2P: Lab 2: Dietetics

Third Semester

PH 811.3 **Food Microbiology** **52 Hours**

Course Learning Objectives:

- To understand the fundamentals of food microbiology.
- To learn the novel methods for detection of immunological components.
- To study the criteria for microbiological assessments in various food products.

Unit I

Introduction, Historical developments of General and Food Microbiology; Classifications of microorganisms; Different sources of microorganisms in foods; Microbial growth curve, factors (intrinsic and extrinsic) affecting growth of microorganisms.

Unit II

Natural micro flora of various foods**:** Food spoilage and microbes of Milk, Fish, Meat, Poultry and other products. Contamination, Preservation and Spoilage of Cereals, Sugars, Fruits and Vegetable products. Measures to prevent microbial food poisoning, Microorganisms important in Foods: Foods and Enzymes produced by microorganisms.

Unit III

Isolation and Detection of Microorganisms: Conventional methods, Rapid methods, Immunological methods, Fluorescent anti body, Radioimmunoassay, ELISA and PCR.

Unit IV

Food microbiology and Public health: Food - borne Illness; Food - borne Poisoning, Infections and Intoxications: Bacterial agents of food poisoning by *Salmonella, Bacillus cereus, Listeria, Clostridium, Staphylococcus*. Non-bacterial agents of food poisoning: Poisonous algae and protozoa. Food poisoning by Fungus: Mycotoxins. Food -borne illness by Viruses.

Unit V

Food Sanitation and Control: Indicator microorganisms for monitoring the quality of foods Ex. *E coli*. Emerging food borne pathogens, recent examples of food borne disease outbreaks. Microbiological criteria for foods such as Milk, fish and meat products. GMP and HACCP. Enforcement and Control agencies.

Broad contents of the course:

- Microbial Growth Curve
- Food Spoilage
- Pathogens
- PCR-RT
- Food borne illness
- Rapid methods
- Indicator Microorganisms
- GMP, HACCP

Course learning outcome:

- Learn the fundamentals of food microbiology.
- Identify the novel methods for detection of immunological components.
- Acquire the knowledge on various criteria for microbiological assessments in various food products.

Recommended Books:

1. James M. Jay (2000).Modern Food Microbiology, 5th Edition, CBS Publishers.
2. Banwart, G.J. (1997) Basic Food Microbiology, CBS Publishers.
3. Adam M.R. & Moss, M.O.(1995) Food Microbiology, New Age International Pvt. Ltd Publishers.
4. Bibek Ray (1996) Fundamental Food Microbiology, CRC Press.
5. Stanier, R.Y. (1996) General Microbiology, V Edition, MacMillan.
6. Pelezar, M.I and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5th Edition.
7. Frazier, W.C. (1988) Food Microbiology, McGraw Hill Inc. 4th Edition.
8. Doyle, P. Bonehat, L.R. and Mantville, T.J (1997) Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.

PH 812.3 Nutraceuticals and Functional Foods in Human Health 52 Hours

Course Learning Objectives:

- To understand the relationship between food, nutrition and health.
- Explore both the industry and the consumer roles involved in this growing field.
- Appreciate the commercial aspect of nutraceuticals.
- To learn the mechanism of action of probiotics.

Unit I

Nutraceuticals: Introduction, classifications and its concepts; Nutraceuticals as a new dietary ingredient; Biological significance. Nutraceuticals and dietary supplements. Functional foods; World market for nutraceuticals and functional foods; Regulatory issues. Relevance of nutraceuticals and functional foods in the management of diseases and disorders.

Unit II

Sources and Health Benefits: Natural pigments like chlorophyll, chlorophyllin, carotenoids, lycopene and anthocyanins; Glucosinolates; Isoflavonoids; Phytosterols; Phytoestrogens; Omega-3 and omega-6 fattyacids; Conjugated Linoleic Acid, Dietary fiber; Antioxidants. Development of functional foods, isolation, storage, processing and stability of phytochemicals and bioactive compounds. Recent developments in the isolation, purification and delivery of phytochemicals.

Unit III

The role of Nutraceuticals and functional foods in disease prevention: Angiogenesis, Cardiovascular diseases, Cancer, Diabetes, Cholesterol management and Obesity. Dosage for effective control of diseases and health benefits with adequate safety. Relation between nutraceuticals and Parkinsons, Alzheimer's diseases. Toxicity potential of nutraceuticals.

Unit IV

Prebiotics, Probiotics and Symbiotics: Introduction, criteria for selection, Role of gastro intestinal microbiota in health and disease; health effects of prebiotics and probiotics. Mechanism of action; Different types of prebiotics and their effects on gut microbes: Resistant starch, Fructo-oligosaccharides; Recent advances in probiotics; Challenges and regulatory issues related to probiotic products.

Unit V

Development of functional foods, isolation, storage, processing and stability of phytochemicals/bioactive compounds. Nutrigenomics: nutrigenomics an introduction and its relation to nutraceuticals. FOSHU Foods.

Broad contents of the course:

- Nutraceuticals
- Phytosterols
- Phytoestrogens
- Dietary fiber
- Antioxidants
- disease prevention
- Prebiotics & Probiotics

Course learning outcome:

- Acquire knowledge on various bio molecules showing health benefits.
- Understand various physiological and biochemical aspects of life threatening and chronic diseases.
- Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
- Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

Recommended Books:

1. Handbook of Nutraceuticals and Functional Foods Edited by. by Robert E.C. Wildman ,Robert Wildman. Taylor C. Wallace , Routledge Publishers, Second Edition, April 26, 2007, ISBN-13: 978-0849364099 ISBN-10: 0849364094

2. Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press, ISBN-13: 978-0853696599 ISBN-10: 0853696594 Edition: 2nd , April 26, 2007

3. Nutrition for the Older Adult by Melissa Bernstein, and Ann Schmidt Luggen (Author), ISBN-13: 978-0763736248 ISBN-10: 0763736244 Edition: 1st , August , 2009

4. Brigelius-Flohé, J & Joos HG. (2006). Nutritional Genomics: Impact on Health and Disease. Wiley VCH.

5. Losso JN. (2007). Angi-angiogenic Functional and Medicinal Foods. CRC Press

6. Robert EC. (2006). Hand book of Nutraceuticals and Functional Foods. 2 nd Ed. Wildman.

7. Shi J. (2006). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.

8. Webb GP. (2006). Dietary Supplements and Functional Foods. Blackwell Pub.

Practicals

PH 813.3P: Lab 1: Food Microbiology & Nutraceuticals and Functional Foods in Human Health

PH 814.3P: Lab 2: Project Work / Internship

Open Elective

PO 815.3 **Health and Fitness** **39 Hours**

Course Learning Objectives:

- To know the basics of health, nutrition and wellbeing
- To understand the concepts of diet and physical fitness
- To Emphasize the importance of proper fueling for physical activity, pre and post-workout
- To learn the special dietary modifications of sports nutrition

Unit I

Definition of Health and Wellness - Factors affecting health and wellness. Physiological, psychological and social health. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing. Gender and health. Nutritional status: Definition methods to assess nutritional status.

Unit II

Fitness - Definition, basic components of physically active life style, Physical fitness tests - for flexibility, muscle endurance (any 3 tests for each) and cardio vascular endurance. Approaches to the management of fitness and health. Diet and exercise – Effect of specific nutrients on work performance and physical fitness. Fuel and other nutrients that support physical activity (metabolic pathways). Mobilization of fuel stores during exercise.

Unit III

Nutrition and Exercise - energy requirement for, aerobic and anaerobic exercises, carbohydrate loading, water and dehydration. Significance of physical fitness and nutrition in prevention and management of weight control diabetes mellitus, CVD, bone health and cancer.

Unit IV

Sports Nutrition - special foods - Nutrition and performance of athetles and players, dietary modifications and diet plan, sports supplementation. Sports specific requirements diet manipulation pre game and post game means, Use of different nutragenic aids and commercial supplements.

Special nutritional needs for monitoring space, military and sea voyage. Awareness about the alternative systems for health and fitness.

Broad contents of the course:

- Health
- Exercise
- Carbohydrate loading
- Weight control
- Supplementation
- Diet plan

Course learning outcome:

- To know the role and importance of nutrition management in exercise and sport performance
- To emphasize the importance of proper fueling for physical activity, pre and post-workout
- To understand the concepts of diet and physical fitness

Recommended Books:

1. Wardlow and Insell – Perspectine in Nutrition.
2. Mary Bronsow Merki and Dow Merki - Health - a guide to wellness
3. Jangalaw Bishop - fitness though aerobic dance.
4. Eleanor Whitney - understanding nutrition.
5. Ira Wolinsky (Ed) (2003): Nutrition in Exercise and Sports, 3rd Edition, CRC Press
6. Parizkova, J. Nutrition, physical activity and health in early life, Ed. Wolinsky, I. CRC Pres

IV Semester

PH 811.4 **Nutritional Biochemistry** **52 Hours**

Course Learning Objectives:

- To understand the carbohydrate, lipid and protein metabolism and its chemistry.
- To have a coherent and systematic knowledge on nucleotides and enzymes.
- To correlate the action of hormones with metabolic regulations.

UNIT I

Nutritional biochemistry aspects of carbohydrates: Biochemical classification of carbohydrate; Physiological functions; Metabolism of glucose, metabolic fate of pyruvate, kreb's cycle, metabolism of glycogen (glycogenolysis, glycogenesis), Glucuronic acid pathway of glucose; Hexose monophosphate shunt pathway; Gluconeogenesis; Metabolism of other carbohydrates: Fructose, Galactose, lactose, amino sugars, Glycoproteins;

Bioenergetics: Energy producing and utilizing systems, thermo dynamic relationships and energy-rich components, Biological Oxidation and Electron Transport Chain.

Unit II

Nutritional biochemistry aspects of Amino acids and Nucleotides: Biochemical classification of amino acids and protein; Physiological functions of amino acid and proteins; Synthesis and breakdown of essential and non- essential amino acids (transamination and deamination). Structure of Nucleotides, synthesis and break down of Purine and Pyrimidines. Nucleic acids: Components, structure and level of organization, Physico-chemical properties, biological importance, DNA replication and enzymes in DNA replication.

Unit III

Nutritional biochemistry aspects of Lipids: Biochemical classification and physiological functions of lipids; Glycolipids; Prostaglandins;, synthesis and Beta-oxidation of fatty acids, stoichiometry in synthesis and breakdown of fatty acids, biosynthesis of cholesterol, phospholipids, triacylglycerol and compound lipids; Regulation of lipid metabolism by products of lipid metabolism: ketone bodies, ketogenesis and ketolysis.

Unit IV

Nutritional biochemistry aspects of Enzymes: Biochemical classification, nomenclature, general properties, mechanism of enzyme action. Coenzymes and cofactors in enzyme activity. Factors affecting enzyme activity, Enzyme inhibition, Isoenzymes, immobilized enzymes, clinical significance of enzyme assays.

Unit V

Hormones: General features and classifications, Chemistry, Biosynthesis, Secretion, Physiological functions, Mechanism and regulation of hormone action.

Broad contents of the course:

- Carbohydrates
- Bioenergetics
- Nucleic acid
- Enzymes
- Lipids
- Hormone

Course learning outcome:

- To describe the concepts and chemistry of major nutrients
- To explain the macronutrient metabolism and its bioenergetics
- To describe protein synthesis and nucleic acid metabolism
- To gain basic knowledge on the synthesis and role of hormones
- Understand the biological processes and systems as applicable to human nutrition.

Recommended Books:

1. Sreemathy Venkatraman; Sucheta Dandekar, Nutrition and Biochemistry for Nurses, Elsevier; First edition (2011).
2. M Yadav, Nutritional Biochemistry and Metabolism, Arise Publishers & Distributors (2007).
3. Tom Brody, Nutritional Biochemistry (Food Science and Technology), Academic Press Inc (1994).
4. Maria C. Linder, Nutritional Biochemistry and Metabolism: With Clinical Applications, Elsevier Science Ltd; New edition (1987).
5. DM Vasudevan, Text book of biochemistry for medical students, Jaypee Brothers Medical Publishers; 8th edition (2016).
6. U. Satyanarayana, Biochemistry, Elsevier Health Science; 3rd edition (2007)

PH 812.4 **Community Nutrition** **52 Hours**

Course Learning Objectives:

- To understand the global and national burden of nutritional deficiencies
- To identify public health nutrition interventions
- To study the impact of nutritional policies and Programmes and nutritional status of the population

UNIT -I

Concept of public nutrition: Relationship between health and nutrition, role of public nutritionists in the health care delivery system. Link between nutrition and demographic changes, Health and nutrition transitions, Economical and public health implications of micro nutrient deficiencies, impact on productivity and national development. Indicators of health and nutrition. Assessment of nutritional status; anthropometric, clinical, biochemical, dietary, vital health status. Basic principles of low cost menu planning. Corporate Social Responsibility (CSR).

UNIT -II

Assessment and surveillance of nutritional status in emergency affected populations: Scope for malnutrition assessment, indicators and simple screening methods. Nutritional relief and rehabilitation: Assessment of food needs, food distribution strategy, targeting food aid, mass and supplementary feeding, special foods/rations for nutritional relief, organization for mass feeding/food distribution, transportation and storage, feeding centers, sanitation and hygiene and public nutrition approach to tackle nutritional and health problems in emergencies, ethical considerations.

UNIT -III

Approaches and strategies for improving nutritional status and health: Programmatic options – Merits and demerits. Intervention Programmes – Health based interventions, Food based interventions including fortification and genetic improvement of foods, supplementary feeding. Role of international and national organizations in public health: FAO, WHO, UNICEF, NIN, NNMB, ICAR, ICMR and ESI. Mid-day meal programme.

UNIT -IV

Information Education Communication approaches to improve health and nutrition: Concepts and Scope. Models of communication; Communication Process; Approaches and Barriers to communication; Communication for Extension Education and Development. Introduction to IEC Aims and Objectives, Importance of IEC and Relevance to programmes: Nutrition education for behavior change, Rationale,

Planning Execution and evaluation of Intervention Programmes. Different Media, their characteristics and use- IEC for different target groups.

Broad contents of the course:

- Public nutrition
- Nutritional status
- Malnutrition
- Intervention Programmes
- Communication approach

Course learning outcome:

- The students will be able to assess the health status of the community
- Students Will know the various organizations related with food and nutrition with its functions
- They are able to provide nutrition counselling and education to individuals, groups, and communities throughout the lifespan using a variety of communication strategies

Recommended Books

1. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
2. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.
3. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Park JE & Park K., 2000. Nutrition in the Community. John Wiley & Sons
5. Shukla PK., 1982. Text Book of preventive and social medicine. Barnasidas Bhanot Publ. SCN News, United Nations. System Forum on Nutrition. WHO.
6. Suryatapa Das (2016) Textbook of Community Nutrition. Publisher: Academic Publishers.
7. Nnakwe (2017) Community Nutrition. Publisher: Jones & Bartlett Learning.
8. Marie A. Boyle, David H. Holben (2012). Community Nutrition in Action: An Entrepreneurial Approach. Edition 6. Publisher: Cengage Learning.
9. Gail C. Frank (2008) Community Nutrition: Applying Epidemiology to Contemporary Practice. Publisher: Jones & Bartlett Learning.
10. Nweze Nnakwe (2012) Community Nutrition: Planning Health Promotion and Disease Prevention. Publisher: Jones & Bartlett Publishers.

PH813.4 **Sports Nutrition** **52 Hours**

Course Learning Objectives:

- To provide a prospect for students to learn new concepts along with the contemporary study design.
- By end of this course student would be able to understand and interpret the concept of sports nutrition
- They would also be able to differentiate the nutritional requirements of sports persons from normal individuals.

UNIT I

Exercise physiology and metabolism: Definitions, Types of exercises (aerobic and anaerobic), limiting factors. Exercise intensity and duration. Adaptations to exercise: physiological and metabolic adaptations to training. Muscle hypertrophy and performance, Fatigue: types, overtraining, oxygen debt theory, EPOC.

UNIT II

Assessment and health and fitness of athletes. Ideal body composition and nutrition for different sports (endurance sports, intermittent, strength & power, martial sports, adventure, swimming and yoga) and events (marathon, triathlon and ultrathon). Significance of physical fitness and nutrition in prevention and management of weight control regimes.

UNIT III

Sports specific Nutrition: effect of specific nutrients on work performance (amino acids, vitamins and minerals) and physical fitness. Nutrients that support physical activity, mobilization of fuel stores during exercise. Importance of carbohydrate loading.

UNIT IV

Meal plan development and recipes for peak performance. Nutritional requirement based on condition: vegetarian, female athletes, veteran athletes and young athletes. Pre-game and post-game meals. Diets for persons with high energy requirements.

UNIT V

Clinical sports nutrition: DM, CVD, Endocrinal disorders. Sports injury: Causes, types, recovery, and role of warm up and cool down. Rehabilitation: concepts, objectives and therapeutic modalities (heat and cold, soft tissue massage). Sports psychology and nutritional counselling.

Broad contents of the course:

- Exercise
- Fatigue
- Sports
- Specific nutrition
- Menu plan
- Rehabilitation
- Sports psychology

Course learning outcome:

- Understand the characteristics, physiology and body composition
- Obtain knowledge on role and importance of nutrition management in exercise and sport performance
- Be familiar with the macro and micronutrient needs of athletes
- Understand the role of nutrition in recovery from injury

Recommended Books

1. William D. McArdle (2020) Sports and Exercise Nutrition 5th Edition. Publisher: Wolters Kluwer.
2. William D. McArdle (2013) Exercise Physiology: Nutrition, Energy, and Human Performance, Publisher Wolters Kluwer Health.
3. Anita Bean (2013) The Complete Guide to Sports Nutrition Edition 7, Publisher: A&C Black.
4. Dan Benardot (2011) Advanced Sports Nutrition, Edition 2, Publisher: Human Kinetics.
5. Jose Antonio, Douglas Kalman, Jeffrey R. Stout, Mike Greenwood, Darryn S. Willoughby, G. Gregory Haff (Edtrs) (2009). Essentials of Sports Nutrition and Supplements. Publisher: Springer Science & Business Media.
6. Heather Hedrick Fink, Alan E. Mikesky (2017) Practical Applications in Sports Nutrition. Publisher: Jones & Bartlett Learning.
7. Muscle and Exercise Physiology (2018) Editor Jerzy A. Zoladz. Publisher: Academic Press.
8. Clinical Exercise Physiology: Application and Physiological Principles (2004) Editors: Linda M. LeMura, Serge P. Von Duvillard. Publisher: Lippincott Williams & Wilkins.
9. ACSM's Advanced Exercise Physiology (2006) Editor: Charles M. Tipton. Contributor: American College of Sports Medicine. Lippincott Williams & Wilkins.

PS 815.4 **Food Safety and Quality Control** **39 Hours**

Course Learning Objectives:

- To study the systematic approach to controlling food safety hazards within a food business.
- To understand the laws, standards and regulation of Food safety.
- To understand guidelines of food safety.

Unit I

Food safety concept: Importance of food safety in the food processing industry. Nutritional and Ingredient labeling: Mandatory and optional nutrients; Nutritional descriptors and approved health claims; Product Identification: Traceability Systems. Food Hazards: Physical, Chemical and Microbial. Quality Control and Assurance: Objectives, Principles, Importance and Functions. Statistical quality control in food industry.

Unit II

Quality Systems: Total Quality Management (TQM); Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Lab Practices (GLP). Standard Operating Procedures (SOP). Sanitation Program: Sanitation Standard Operating Procedures (SSOPs). Food adulteration: Nature of adulterants, methods of evaluation and toxic constituents.

Unit III

Hazard Analysis Critical Control Point (HACCP) system. Evaluation of severity of a hazard controlling food hazards. Food Hygiene Program: Training programs, Hygiene verification. Water Quality in Food Industry; Cleaning and Sanitation: Cleaning agents, Sanitizing agents and Evaluation of sanitation efficacy. Pest Classification: Insects, Rodents and Birds; Integrated Pest Management (IPM) and control measures. Organic Farming.

Unit IV

Food Safety regulations and management systems: National and International food quality regulations: BIS, FSSAI, ISO (9000; 14,000; 15,161 and 22,000) and EU. Codex Alimentarius Commission; Introduction to the legal system, Principles of self-quality, Risk analysis on food. WTO agreements: SPS and TBT agreements. Current challenges in food safety.

Broad contents of the course:

- Food safety concept
- Traceability Systems
- Statistical quality
- Quality Systems
- Food adulteration
- Hazard Analysis Critical Control Point (HACCP) system.
- Food Safety regulations and management systems
- Codex Alimentarius Commission

Course learning outcome:

- Understand, use and apply the knowledge, skills of quality management in food processing.
- Understand and critically evaluate the presence of contaminants in food quality assurance.
- Understand the chemical, technological and toxicological aspects of food additives in food preservation.
- Understand the concept of food safety, types of hazards and their control measures
- Comprehend the need of hygiene and sanitation for ensuring food safety

Recommended Books:

1. Early, R. (2005): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (2006). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Pomeraz, Y. and MeLoari, C.E. (2006): Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.
4. Bryan, F.L. (2000): Hazard Analysis Critical Control Point Evaluations a Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva.
5. FSSAI, FSIS, EU and FAO website for updates
6. Ronald H. Schmidt, Gary E. Rodrick (2005) Food Safety Handbook, John Wiley & Sons Publisher (ISBN 047143227X, 9780471432272)
7. Rajesh, M., and George, J. (2005) “Food Safety Regulations, Concerns and Trade: The Developing Country Perspective”, Macmillan.
8. Naomi, R., and Watson, D. (2007) “International Standards for Food Safety”, Aspen Publication.
9. Newslow, D.L. (2007) “The ISO 9000 Quality System: Applications in Food and Technology”, John Wiley & Sons.
10. Hubbard, Merton R. (2003) “Statistical Quality Control for the Food Industry”, 3rd Edition, Springer,

PS 816.4 **Assessment of Nutritional Status** **39 Hours**

Course Learning Objectives:

- To learn the direct and indirection methods of assessment
- To understand food and nutrition security adding light to its systems
- To study nutrition through life span and age specific nutritional requirements

Unit I

Indirect methods - Demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR).

Unit II

Direct methods - Anthropometry, Biochemical, Clinical, Dietary and Functional indices of assessments

a. Anthropometry – methods, reference standards in children and adults, scales of comparison (percentiles, Z score), classification and interpretation of somatic data, somatic indicators of PEM
b. Biochemical - use of specimen types, indicators of protein-energy status, anemia, immune function, CVD risk, oxidative stress. Urine and stool analyses.
c. Dietary- methods, nutrient intake analysis, dietary assessment in special populations and specific situations, Dietary reference intakes
d. Clinical- components of clinical assessment, associations with nutrient deficiencies and biochemical status

Unit III

Assessing food and nutrition security – Definition and assessment schedules, National and household food security. Factors affecting food security system. National and International systems to improve food security.

Unit IV

Nutrition during life span-

a. Pregnancy: Physiological adjustments, Nutritional requirements, Nutritional status of Indian pregnant women. Effect of malnutrition on outcome of pregnancy.
b. Lactation: physiology of lactation, Factors affecting lactation, nutritional requirements. Effect of lactation on maternal malnutrition and fertility
c. Infancy: Growth and development, nutritional requirements. Feeding pattern, compositional differences between human milk and milk substitute and their suitability for infant feeding. Weaning practices, weaning and supplementary foods.
d. Preschool age: Growth and development, nutritional requirements, special care in feeding them, nutritional problems specific to this age.
e. School age and adolescent children: Growth and development, nutritional requirements, special care in feeding preschoolers, nutritional problems specific to this age.
f. Young adults: Nutritional requirements, Nutrition status of Indian adult population, nutritional problems common to this age.

Recommended Books:

1. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
2. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.
3. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Bamji, M.S., Rao, P.N., Reddy, V (Eds) (2003): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Practicals

PH 814.4P: Lab 1: Nutritional Biochemistry and Food Safety and Quality Control

PS 817.4P: Lab 2: Community Nutrition