

# VIDYASAGAR UNIVERSITY



**Post Graduate (M.Sc.)**

**Syllabus in**  
**CLINICAL NUTRITION AND DIETETICS**  
**(CND)**

**Under New Education Policy (NEP) 2020 Guidelines**

**(Effective from Academic Year 2025-2026)**

## Preamble

The M.Sc. in Clinical Nutrition & Dietetics is a specialized two-year postgraduate program introduced in 2012 at Vidyasagar University under the UGC Innovative Program. Designed with a strong clinical orientation, the program aims to cultivate advanced knowledge and skills in clinical nutrition to address the growing demand for qualified professionals in hospitals, healthcare institutions, and therapeutic nutrition services. In line with this academic vision, the department also launched a Ph.D. program in Clinical Nutrition to promote research-driven excellence in disease-specific nutritional science and evidence-based clinical practice.

Successfully running for over a decade, the program offers robust career prospects in clinical nutrition, therapeutic dietetics, hospital-based nutritional care, medical research, and nutrition consultancy.

Aligned with the National Education Policy (NEP) 2020, the upgraded syllabus offers a structured and progressive learning experience. The curriculum spans four semesters over two years, with 22 credits per semester, totalling 88 credits. Each semester is carefully crafted to strengthen both the core and advanced competencies in clinical nutrition, including medical nutrition therapy, metabolic disorders, critical care nutrition, nutritional biochemistry, and clinical assessment techniques.

The program is led by a team of experienced and qualified professionals. Students are trained in modern classrooms equipped with ICT tools and advanced laboratories featuring diagnostic and research-grade equipment. The curriculum emphasizes practical clinical exposure through partnerships with leading hospitals and healthcare institutions, offering students hands-on training and real-world insight into contemporary clinical nutrition practices.

## Program Outlines

1	Type of Program	This is a regular mode M.Sc. program, based on the guidelines of NEP 2020.
2	Duration and Eligibility Criteria	3 Yrs B.Sc. Hons under CBCS/ 3 Yrs B.Sc. (single major) under NEP in Nutrition/Nutrition and Dietetics/ Clinical Nutrition & Dietetics/ Food Science/Physiology/ Molecular Biology/ Zoology/Biochemistry/BioTechnology/Home Science/ Microbiology/Human Development/B.Sc. in Nursing/BHMS
3	Intake capacity	The current intake capacity of the program is 41 <b>students</b> . Admission is carried out in accordance with the prevailing government norms, and the <b>reservation rules for EWS, OBC, SC, ST, PWD, and other applicable categories</b> are strictly followed.

4	Admission procedure	<p>The university administers a written admission test as a key component of the selection process. Admission decisions are primarily based on performance in this test, with additional consideration given to marks obtained in the Undergraduate (UG) program depending on the applicant's qualifications. The Admission Committee is responsible for managing the entire process, ensuring that all rules and regulations are properly followed.</p>
5	Evaluation Process	<p>Student assessment will be based on a combination of continuous evaluation and an end-semester examination. Continuous Evaluation (CE) will contribute 20% to the final grade, while the End-Semester Examination will carry the remaining 80%.</p> <p>Each course will include two CE assessments, with the final CE score calculated as the average of the two. These assessments may take various forms, including multiple-choice questions (MCQs), open-book tests, take-home assignments, case studies, written tasks, mini-projects, or presentations.</p> <p>The end-semester examination will feature a mix of short, medium, and long-answer questions to thoroughly assess students' conceptual understanding and analytical abilities.</p>
6	Teaching Methods	<p>To effectively achieve the intended learning outcomes, a diverse range of teaching and learning methodologies will be employed:</p> <ul style="list-style-type: none"> <li>• <b>Lecture-Based Instruction</b> – Key theoretical concepts will be delivered through structured, instructor-led sessions to provide a strong foundational understanding.</li> <li>• <b>Collaborative Learning</b> – Group discussions, team-based activities, and peer interaction will be encouraged to enhance communication, cooperation, and the exchange of ideas.</li> <li>• <b>Independent Learning</b> – Students will engage in self-directed study, allowing for deeper reflection, personalized pacing, and the development of autonomous learning skills.</li> <li>• <b>Technology-Enhanced Learning</b> – Digital tools, online resources, and interactive platforms will be integrated to enrich the learning experience and foster engagement.</li> <li>• <b>Peer Teaching</b> – Opportunities for students to explain and present concepts to their peers will promote active participation and reinforce subject mastery.</li> <li>• <b>Problem-Based Learning</b> – Real-world problems, case</li> </ul>

		studies, and analytical exercises will be used to develop critical thinking, problem-solving abilities, and practical application of knowledge.
7	Special Instructions	To align with NEP 2020, the syllabus includes compulsory general courses such as Indian Knowledge System (IKS), IPR, Research Methodology and Ethics, Social Service, Internship or Industry Project, Field Visit, Research Project, and the Life and Philosophy of Vidyasagar. Core courses build subject foundations, while elective papers offer flexibility, with students required to choose one from the available options.
8	Research Projects	The research project will be distributed by the mentor to the students in third semester and it will be evaluated in final semester.

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## Program Outcomes (POs)

Upon successful completion of the M.Sc. in CND program, students will be well-equipped to:	
<b>PO1</b>	Demonstrate in-depth understanding of human nutrition, biochemistry, physiology, and dietetics principles relevant to health and disease management.
<b>PO2</b>	Apply evidence-based nutritional assessment, diagnosis, and intervention strategies in clinical and community settings.
<b>PO3</b>	Communicate effectively with patients, healthcare professionals, and the public through counselling, education, and dissemination of nutritional knowledge.

## Programme Specific Outcomes (PSOs)

After the successful completion of M.Sc.in CND program, the students are expected to	
<b>PSO1:</b>	Understand the advanced pathophysiology of different diseases, nutrimerics , biomarkers related to the clinical nutrition.
<b>PSO2:</b>	Understand the basics and clinical applications and dietary management of metabolic, lifestyle, respiratory disorders.
<b>PSO3:</b>	Understand the microbiological aspect of food, food preservation, food laws, sanitation , hygiene in different hospital and community .
<b>PSO4:</b>	Focus on advanced public health and nutritional health education and policies.

**Syllabus in semester system of M.Sc. in Clinical Nutrition and Dietetics**

**NEP COURSE STRUCTURE**

Sem.	<b>PG1<sup>st</sup>Year</b>		
<b>I</b>	Course	Credit (L+T+P)	Marks (T+P)
	DSC1 (Major 14)- Advanced Physiology and Pathophysiology	4	50+0
	DSC2 (Major 15)– Nutrimerics and Biomarkers	4(2+0+2)	25+25
	DSC3-Research Methodology and Ethics	4	50
	DSE1(Major Elect.3) – Biochemical and Molecular Techniques	4(2+0+2)	25+25
	DSE2– Computational Skill And Statistics For Nutritional Data Analysis	4(2+0+2)	50
	DSC4 –Nutraceuticals and Application of Nanotechnology	4(2+0+2)	25+25
	Indian Knowledge System (IKS)	2	25
	Vidyasagar: Life and Philosophy	Compulsory non-credit course	
	<b>Total</b>	<b>22</b>	<b>275</b>
Sem.	<b>PG1<sup>st</sup>Year</b>		
<b>II</b>	Course	Credit(L+T+P)	Marks (T+P)
	DSC4(Major 16)-Clinical Nutrition Therapy I – Metabolic, Respiratory and Lifestyle Disorders and Dietary Management	4	50
	DSE3(Major Elect.4) -Clinical Nutrition Therapy II – GI, Liver, Renal, Autoimmune Disorders	4	50
	DSE4(Major Elect.5)-Nutridynamics and Nutriomics	4	50
	DSE5(Major Elect.6) – Nutritional Counseling and Entrepreneurial Development	4	50
	DSC4 /DSE - Dietary Management of Different Diseases	(0+0+4)	50
	Field Visit / Community Survey For The Control And Prevention Of Different Nutrient Deficient Condition (Anthropometric , Clinical Symptoms Assessment) and Awareness Programme	2	25
	<b>Total</b>	<b>22</b>	<b>275</b>
Sem.	<b>PG2<sup>nd</sup>Year</b>		
	Course	Credit	Marks(T+P)

<b>III</b>		<b>(T+L+P)</b>	
	<b>DSC5</b> -Sports Nutrition & Performance Nutri Medicine	<b>4(2+0+2)</b>	<b>25+25</b>
	<b>DSC 6</b> - Clinical Nutrition Therapy III- Geronto-nutrition, Onco-Nutrition,Neurological Nutrition	<b>4(2+0+2)</b>	<b>25+25</b>
	<b>DSC 7</b> -FoodMicrobiology and FoodPreservation	<b>4</b>	<b>50</b>
	<b>DSC 8</b> - Food laws,FoodSanitationand Hygiene in Hospital and Community	<b>4</b>	<b>50</b>
	MOOCs	<b>4</b>	<b>50</b>
	Visit to healthy food manufacturing unit / visit food research center / visit coastal areas / high altitude for food safety and sanitation survey	<b>2</b>	<b>25</b>
	Total	<b>22</b>	<b>275</b>
<b>Sem.</b>	<b>PG2<sup>nd</sup> Year</b>		
<b>IV</b>	<b>Course</b>	<b>Credit (T+L+P)</b>	<b>Marks (T+P)</b>
	<b>DSC10</b> - Clinical Nutrition Therapy IV-Critical Care Nutrition and Palliative care	<b>4(2+0+1)</b>	<b>25+25</b>
	<b>DSC 11</b> - PublicHealth and Nutritional Health Education and Policies	<b>4</b>	<b>50</b>
	Researchproject/Dissertation	<b>8</b>	<b>100</b>
	Internship/Capstone project/ Applied Field or Industry project/InnovationandIncubation/Entrepreneurship/Start-up Proposal or Practice	<b>4</b>	<b>50</b>
	IntellectualPropertyRight(IPR) Skill Enhanced Course	<b>2</b>	<b>25</b>
	Preparation of smart food and common therapeutic food		
	Total	<b>22</b>	<b>275</b>
	<b>Total</b>	<b>88</b>	<b>550</b>

# Syllabus in semester system of M.Sc. in Clinical Nutrition and Dietetics

## NEP Course Structure

### Semester – I

#### **DSC 1 (Major 14)- Advanced Physiology and Pathophysiology**

##### **Learning Objectives:**

- Describe the structure, function, and integration of major organ systems, along with key cellular transport mechanisms (passive and active).
- Explain the hormonal and neural regulation of gastrointestinal, cardiovascular, renal, and endocrine systems.
- Analyze the pathophysiological basis of common gastrointestinal, hepatic, cardiovascular, renal, and endocrine disorders.
- Evaluate the role of immune function, oxidative stress, and inflammation in the development and progression of chronic diseases.

##### **Course Outcomes (COs):**

CO1 : Demonstrate an integrated understanding of body systems and cellular transport in maintaining physiological balance.

CO2 : Interpret regulatory mechanisms and disease processes across major organ systems using current physiological and pathophysiological principles.

CO3 : Critically assess the impact of immune responses, inflammation, and oxidative stress in non-communicable diseases such as diabetes, cardiovascular disease, and cancer.

##### **Course Content:**

- **Organization of Body Systems**

Overview of organs, systems and their functions. Integration and communication between and among systems.

- **Cell Transport Mechanisms**

Passive transport including diffusion, osmosis, and facilitated diffusion. Active transport (primary and secondary). Endocytosis and exocytosis.

- **Gastrointestinal & Hepatic System**

Overview of gastrointestinal system , gastrointestinal reflex.

Hormonal Regulation of the GI Tract: role of gastrin, secretin, cholecystokinin (CCK), motilin, and ghrelin. Role of the enteric nervous system in gut regulation.

Pathophysiology of Common GI and Liver Disorders: Overview of gastroesophageal reflux disease (GERD), inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), non-alcoholic fatty liver disease (NAFLD), and liver cirrhosis.

- **Cardiovascular & Renal Systems**

Overview of blood Pressure Regulation: Functions of baroreceptors and chemoreceptors. Role of the renin-angiotensin-aldosterone system (RAAS). Roles of antidiuretic hormone (ADH) and natriuretic peptides.

Fluid and Electrolyte Balance

Pathophysiology of Cardiovascular and Renal Disorders: Clinical aspects of hypertension, atherosclerosis, chronic kidney disease (CKD), nephrotic syndrome, uraemia and renal dialysis.

- **Endocrine & Metabolic Disorders**

Hormonal Regulation of Metabolism: Roles of insulin, glucagon, thyroid hormones, cortisol, growth hormone, leptin, and adiponectin in metabolic control.

Endocrinal Pathophysiology of metabolic syndrome, and thyroidal disorders (hypothyroidism and hyperthyroidism).

- **Immunology, Inflammation & Oxidative Stress**

Brief concept of immunity, nutrient as immuno-booster, immuno-enhancer and immuno-suppressor

Oxidative Stress: and antioxidant defense systems and impact on cellular and molecular integrity.

Inflammatory pathways including NF-κB and cytokines. The role of chronic inflammation in non-communicable diseases such as cardiovascular disease, diabetes, obesity, cancer, and neurodegenerative conditions.

### CO–PO–PSO Mapping (High/Medium/Low)

CO	PO1	PO2	PO3	POS1	POS2	POS3	POS4
CO1	H	M	M	H	M	L	L
CO2	H	M	H	H	M	M	M
CO3	H	L	M	H	H	H	L

## **DSC 2T (Major 15) –Nutrimetrics and Biomarkers**

### **Learning Objectives:**

- Understand the foundational concepts of nutrimerics, including its domains, scope, and evolution from classical to modern digital approaches in anthropometric assessments.
- Analyze and apply various anthropometric indices and methods, both traditional and advanced, to assess nutritional and body composition status.
- Interpret key biochemical biomarkers relevant to macronutrient and micronutrient status, hydration, and enzyme activity for evaluating nutritional health.

### **Course Outcomes(COs):**

**CO1:** Conduct and interpret traditional and digital anthropometric assessments.

**CO2:** Apply advanced tools (DEXA, BIA, AI) for body composition analysis.

**CO3:** Evaluate nutritional status using key biochemical biomarkers and integrate nutrimerics with smart health technologies for personalized nutrition.

### **Course Content:**

#### **1. Introduction to Nutrimerics**

- Concept, domains and scope of Nutrimerics
- Anthropometry in modern nutrition science
- Evolution from classical methods to digital smart assessment

#### **2. Anthropometric Indices and Application**

- Traditional measurements: Height, Weight, BMI, MUAC, Chest Circumference, Head circumference, waist-hip ratio, skinfold thickness, visceral fat index, conicity index, anthro-genomic dashboard
- Growth charts, Z-scores, percentile-based assessment
- Advanced methods: DEXA, BIA, 3D and digital body scanning, AI enabled anthropometric analytics
- Smart devices and digital health applications in anthropometry

#### **3. Biochemical Biomarkers of Nutritional Status**

- Overview of nutritional biomarkers (direct vs functional)
- Micronutrient biomarkers (iron, vitamin D, iodine, zinc, folate, B12)
- Macronutrient biomarkers (protein status, lipid profiles, carbohydrate metabolism major bio markers)
- Biomarkers of hydration and electrolyte balance
- Enzyme characteristics, nomenclature, kinetics, control of enzyme activity.

## **DSC 2P (Major 15) –Nutrimetrics and Biomarkers**

### **Anthropometric Assessment**

1. Height, Weight, BMI, Arm Circumference, waist–hip ratio, skinfold thickness, BIA.
2. Growth charts, Z-scores, percentile-based assessment

### **Biochemical Biomarkers Assessment**

1. Blood glucose, lipid profile, Plasma protein, Serum iron, Serum calcium assessment

### **CO–PO–PSO Mapping (High/Medium/Low)**

<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>POS1</b>	<b>POS2</b>	<b>POS3</b>	<b>POS4</b>
<b>CO1</b>	M	H	M	M	H	L	L
<b>CO2</b>	M	H	H	L	H	M	M
<b>CO3</b>	H	H	M	M	M	H	L

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## **DSC 3- Research Methodology and Ethics**

### **Learning Objectives:**

- To introduce the fundamental concepts, characteristics, and types of research, and to distinguish between research methods and methodology.
- To develop the ability to identify and formulate research problems, review literature critically, and frame appropriate research questions and hypotheses.
- To equip students with knowledge of research design, data collection methods, sampling techniques, and proposal writing skills.
- To cultivate ethical awareness in research by emphasizing research integrity, academic honesty, and responsible conduct in data handling and publication.
- To familiarize students with research metrics, publication ethics, and modern tools for evaluating the quality and impact of research.

### **Course Outcomes (COs):**

**CO1:** Exhibit familiarity with the reading, assessing, and developing stages of the research process.

**CO2:** Determine, elucidate, contrast, and compile the essential components of a study proposal or report.

**CO3:** Describe and create a potential research proposal utilizing particular research designs.

**CO4:** Analyze the differences between the paradigms of qualitative and quantitative research.

**CO5:** Explain measurement tools and scales, sample techniques, and the proper applications for each.

**CO6:** Using appropriate examples, describe, evaluate, and use computational techniques and descriptive and inferential statistics.

### **Course Content:**

- 1. Data and Methods of Data Collection:** Survey, assessment, and analysis: data collection, primary and secondary sources of data, and collection of primary data through questionnaires and schedules. Collection of secondary data, processing, and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling, and multistage sampling. The pilot survey, scaling techniques, validity & reliability.

2. **Good Experimental, Observational, and Data Analysis, including Computer Applications:** Maintenance of laboratory records & e-Note books, Management of data and self-navigation of the research project and academic program progress (objectives and milestones as well as timeline compliance), Data integrity & archiving of observational data for retracing, Basic mathematical and statistical treatments of data for appropriate/rational interpretation, statistical analyses (descriptive and inferential statistics), common computational tools like a process flow diagram, chemical structure drawing, and writing SOP Data tabulation and figure presentation (graph, bar diagram, Venn diagram, heat maps, etc.) and data visualization—any suitable software-like Google Studio, etc.
3. **Writing & Communication of Research:** Scientific writing (including language proficiency), state-of-the-art scientific literature comprehension, Art and ethics of writing research reports/papers and writing of an abstract for the scientific community and general public.
4. **The Research Proposal:** The Introduction, Review of Literature, The Method Section, The Results Section, The Discussion Section, and The References as per standard formats.
5. **Research ethics:** Guidelines, plagiarism, fabrication, falsification, copyright, authorship, correspondence, citation, plagiarism checking tools.

**CO–PO–PSO Mapping (High/Medium/Low)**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	H	L	H	M	M	L
CO2	H	H	H	M	H	L	H	H	M	L
CO3	H	H	H	M	H	M	H	H	M	L
CO4	H	H	H	M	H	M	H	H	M	L
CO5	M	M	M	M	M	L	M	M	M	M
CO6	M	M	L	L	L	L	M	M	M	L

## **DSE 1T (Major Elect. 3) – Biochemical and Molecular Techniques**

### **Learning Objectives:**

- Understand and evaluate the evolution and application of biochemical techniques in clinical nutrition and the biochemical markers associated with key nutritional disorders.
- Analyze and interpret nutrient-specific biochemical markers, including proteins, lipids, and carbohydrates, to assess nutritional status and metabolic health.

- Explain the role of redox biochemistry in nutrition, including oxidative stress and antioxidant interactions, and their relevance to disease states.
- Apply molecular techniques such as PCR and Western blotting to investigate nutrient–gene interactions and assess functional nutrient-related biomarkers.

### **Course Outcomes (COs):**

**CO1:** Critically assess biochemical indicators of malnutrition, obesity, metabolic syndrome, and diabetes using current clinical and laboratory tools.

**CO2:** Perform and interpret biochemical tests for key macro- and micronutrient markers relevant to nutritional assessment and disease management.

**CO3:** Demonstrate proficiency in analyzing oxidative stress biomarkers and understanding antioxidant nutrient dynamics in human health.

**CO4:** Utilize molecular biology techniques to explore nutrigenomic relationships, including gene expression and protein-level responses to dietary components.

### **Course Content:**

#### **1. Conceptual Framework**

- Evolution of biochemical techniques in clinical nutrition.
- Biochemical signatures of malnutrition, metabolic syndrome, obesity, diabetes

#### **2. Nutrient-Specific Biomarker Analysis**

- Proteins: Serum albumin, prealbumin, transferrin as nutritional indicators.
- Lipids: Lipoprotein fractions and their nutritional relevance.
- Carbohydrates: Glycemic indices, advanced glycation end-products (AGEs).

#### **3. Redox Biochemistry in Nutrition**

- Oxidative stress biomarkers (MDA, GSH, SOD, catalase).
- Antioxidant nutrient interactions (vitamins C, E, selenium).

#### **4. Micronutrient Biochemistry**

- Functional biomarkers for iron (ferritin, transferrin saturation), zinc (alkaline phosphatase), iodine (urinary iodine).
- Biochemical monitoring of vitamin D–calcium–parathyroid axis.

#### **5. Molecular Techniques in Nutrigenomics**

- Introduction to Nutrigenomics: Role of nutrients in regulating gene expression, interaction between diet, genome, and health outcomes.

- PCR (Polymerase Chain Reaction): Principles, types (conventional PCR, RT-PCR, qPCR), and applications in assessing nutrient–gene interactions and transcriptional changes.
- Western Blotting: Principles and methodology for protein detection; application in studying nutrient-regulated protein expression and translational modifications.

### **DSE 1P (Major Elect. 3) – Biochemical and Molecular Techniques**

- **ELISA for Hormonal Assay:** Insulin, Leptin, Ghrelin, Adiponectin, TSH.
- **Polymerase Chain Reaction (PCR) For Gene Expression Analysis**
- **Western blot for protein expression analysis**

#### **CO–PO–PSO Mapping (High/Medium/Low)**

CO	PO1	PO2	PO3	POS1	POS2	POS3	POS4
CO1	M	M	H	H	M	M	L
CO2	H	M	H	L	H	H	M
CO3	H	L	M	M	H	L	L
CO4	M	H	L	H	L	M	H

### **DSE 2T – Computational Skill and Statistics for Nutritional data analysis**

#### **Learning Objectives:**

- To develop conceptual clarity on statistical measures including central tendency, variation, location, and dispersion; and learn how to classify, tabulate, and represent data effectively.
- To gain proficiency in using frequency distributions, histograms, probability distributions (binomial and normal), and interpret statistical tables.
- To apply parametric and non-parametric tests such as t-tests, chi-square tests, ANOVA, and regression to draw valid inferences from data.
- To effectively use MS Excel, SPSS, OriginLab, and other statistical software for data analysis, visualization (bar, pie, line diagrams), and application in food analysis.

#### **Course Outcomes (COs):**

**CO1:** Compute and interpret statistical measures such as mean, median, standard deviation, and effectively apply frequency distributions and graphical methods for data summarization.

**CO2:** Apply suitable parametric and non-parametric tests including t-tests, chi-square tests, and ANOVA; interpret p-values and identify Type I and Type II errors.

**CO3:** Perform and interpret correlation and regression analyses, develop prediction models, and apply ANOVA with post-hoc tests such as Tukey’s and Dunnett’s.

**CO4:** Utilize tools such as MS Excel, SPSS, and OriginLab for statistical analysis, data visualization, and reporting, with applications in real-world scenarios like food analysis.

**Course Content:**

1. Conceptual understanding of statistical measures, Classification and tabulation, Measurement of central tendency, Measurement of variation, statistics of location, statistics of dispersion.
2. Frequency distribution, Histogram, Frequency polygon, Binomial distribution, Normal distribution-use of probability table.
3. Parametric and non-parametric test, testing of hypothesis-Type I and Type II error, Chi-square test, Goodness of fit, Application of student 't' test for samples Difference in proportion for mean and difference in means.
4. Correlation, Coefficient of correlation and rank correlation, Regression and prediction, model-I and II ANOVA and F test and critical F test, Tukey's test and Dunnet test
5. Experimental design, completely randomized design, Randomized block design, Latin square designs, Factorial design, Trend analysis.
6. Basic computer architecture, Software's-use of MSword, MSEXCEL-Bar diagram, Piediagram and line diagram, MS power point.
7. Application of statistics, Application of SPSS, Origin lab, Software, Use of software for food analysis.

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**DSE 2P– Computational Skill and Statistics for Nutritional data analysis**

- Software's-use of MSword, MSEXCEL-Bar diagram, Pie diagram and line diagram, MS power point.
- Application of statistics, Application of SPSS, Origin lab, Software, Use of software for food analysis.

**CO–PO–PSO Mapping (High/Medium/Low)**

CO	PO1	PO2	PO3	POS1	POS2	POS3	POS4
CO1	M	M	H	H	M	M	L
CO2	H	M	H	L	H	H	M
CO3	H	L	M	M	H	L	L
CO4	M	H	L	H	L	M	H

## **DSC4 T–Nutraceuticals and Application of Nanotechnology**

### **Learning Objectives:**

- To define nutraceuticals and understand their chemistry, sources, metabolism, and bioavailability, including their physiological effects on chronic disease prevention.
- To study various bioactive plant compounds (polyphenols, phytoestrogens, phytosterols) and antinutritional factors (phytates, protease inhibitors, etc.) and their health implications.
- To examine the principles of genetically modified (GM) foods, food fortification, and the application of nanotechnology in enhancing nutraceutical delivery and effectiveness.
- To perform extraction, isolation, chromatographic separation, quantitative estimation of phytochemicals, and synthesis/characterization of nanoparticles using modern techniques.

### **Course Outcomes (COs):**

**CO1:**Demonstrate a comprehensive understanding of nutraceuticals, their sources, metabolism, and roles in promoting health and reducing disease risk.

**CO2:**Analyze and differentiate various classes of bioactive and antinutritional compounds through both theoretical and practical approaches.

**CO3:**Evaluate the significance and methodology of GM foods, nanotechnology applications, and nano-fortified foods in enhancing nutritional value and food functionality.

**CO4:**Perform laboratory techniques including solvent extraction, TLC, column chromatography, antioxidant assays, and nanoparticle synthesis, and interpret analytical data for nutraceutical compounds.

### **Course Content:**

- 1. Nutraceuticals with Potential Health Benefit:** Definition, chemistry, sources, metabolism, and bioavailability.
- 2. Physiological Effects and Disease Risk Reduction:** Role of nutraceuticals in promoting health and reducing chronic disease risks.
- 3. Bioactive Plant Compounds:** Polyphenols (flavonoids, catechins, tannins), phytoestrogens, phytosterols, pigments (lycopene, curcumin).
- 4. Antinutritional and Functional Compounds:** Phytates, protease inhibitors, amylase inhibitors, haemagglutinins, saponins.

5. **Genetically Modified (GM) Foods:** Concept, definition, available GM foods in India, techniques for GM food preparation, and food fortification.

6. **Nanotechnology in Nutraceuticals**

- Nanoencapsulation for Enhanced Bioavailability: Improving solubility, stability, absorption, and targeted delivery of nutraceuticals.
- Nanocarriers in Food Systems: Liposomes, nanoemulsions, solid lipid nanoparticles, polymeric nanoparticles.
- Nano-fortified/ designer Foods: Nano fortification of food, improvement of nutritional quality and shelf life.
- Safety and Regulatory Concerns: Toxicity, stability, and ethical considerations of nano-based nutraceuticals.

### DSC4P-Nutraceuticals and Application of Nanotechnology

1. **Extraction & Isolation:**

- Extraction of Phyto molecules using different solvents.
- Identification of bioactive compounds (polyphenols, flavonoids, alkaloids, saponins, etc.) from chromatographic data (demonstration).

2. **Separation techniques:** TLC, column chromatography.

3. **Quantitative Estimation**

- Total phenolic content (Folin-Ciocalteu method).
- Total flavonoid content (AlCl<sub>3</sub> method).
- Antioxidant activity assays: DPPH, ABTS, FRAP.

4. **Nanoparticle Synthesis & Formulation (demonstration):**

- Preparation of polymeric nanoparticles (e.g., chitosan, PLGA).
- Green synthesis of metallic nanoparticles (AgNPs, AuNPs) using plant extracts.
- UV-Vis spectroscopy for nanoparticle confirmation.

### CO-PO-PSO Mapping (High/Medium/Low)

CO	PO1	PO2	PO3	POS1	POS2	POS3	POS4
CO1	M	M	H	H	M	H	H
CO2	H	M	H	L	H	M	M
CO3	H	L	M	M	H	L	H
CO4	M	H	L	H	L	H	H