Shiromani Gurdwara Parbandhak

Committee's

Guru Nanak Khalsa

College of

Arts, Science and Commerce

(Autonomous)

Matunga, Mumbai – 400 019, Maharashtra

Syllabus for M.Sc. Nutraceuticals

Program: Master of Science

Course: M.Sc. Nutraceuticals (NEP 2020)

(As per Choice Based Semester and Grading System with effect from Academic Year 2025 – 2026)

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Semester I and II

(As per NEP guidelines-DSC model) With

effect from Academic Year 2025 - 2026)

INDIAN NUTRACEUTICAL INDUSTRY

Indian Nutraceutical industry has recently proved its mite both at national and international arena. With the WTO regime just rising on the horizon our nutraceuticals are in for a great boom especially in European and American regions. The market for these products is expected to rise in the coming years especially in lifestyle medicines. Traditional systems of medicine in India will be playing a major role in these since Indian systems of medicines have been traditionally emphasizing on constitutional medicines.

INADEQUACY OF TRAINED PERSONNEL

Major hurdle faced by the R&D centres at various companies is the lack of adequately trained and appropriately oriented personnel. The lacunae become more evident when dealing with newer formulations and naturally derived food supplements. There is a dire need for standardization techniques based on modern instrumental procedures and principles to ensure consistent quality of the nutraceutical products. A major hurdle in achieving this is the lack of adequate expertise among the manufacturers, the national laboratories and other Testing and research centres. This lacuna needs to be addressed very diligently, and the proposed programme is a step in this direction. Nutraceutical science is an interdisciplinary knowledge area and requires highly skilled personnel with strong background of both instrumental and non-instrumental (bioassays) techniques. There is no programme available today for such a training to generate such expertise in students. There is a dire need of technical personnel with an overall expertise in human nutrition, various bioanalytical techniques, biological techniques and regulatory requirements to be able to take up R&D in nutraceutical industry. The proposed programme has been planned to address this need of trained personnel.

OBJECTIVES OF THE PROGRAM

- To provide a platform to collaborate actively with Industry.
- Develop trained manpower in the field of nutraceutical Sciences with specific emphasis for exploitation of traditional system of medicine as well as the need for changing trends in the nutraceutical Industry.
- Training in the formulation, processing, manufacture, and packaging requirements of nutraceuticals.
- Amalgamate conventional biological sciences with modern genomic and proteomic technologies of manufacturing and analysis of nutraceuticals.
- Impart knowledge of specialty nutraceuticals their design requirements.
- Exposure to National & International regulatory affairs with reference to Nutraceuticals.

ELIGIBILITY:

A candidate for being eligible for admission to the M.Sc. Degree course in Nutraceuticals must have passed from any recognized University in India with minimum 50% marks in aggregate for students belonging to general category and 45% marks for students belonging to Reserved category or equivalent grade with any of the following science subjects of the B.Sc. course: Chemistry, Botany, Zoology, Microbiology, Life science, Biotechnology, Biochemistry, Five Years Integrated M. Sc. Degree Course in Bioanalytical Sciences. B.Voc. with food science, nutrition related and alternatively, students with degree in medical sciences or Graduation in food and nutrition sciences or Pharmacy with aggregates marks as mentioned above for B.Sc. degrees are also eligible.

PROGRAM OUTCOME

The student will be skilled in the nutraceutical sciences with a focus on utilizing the conventional medical system and the necessity of adapting to new trends in the nutraceutical industry.

The students will receive training in the due diligence, manufacturing, and packaging requirements for nutraceuticals.

The students will be able to combine traditional biological sciences with advanced genomic and proteomic methods of nutraceutical synthesis and analysis.

The students will be thorough with the regulatory issues relating to nutraceuticals on a national and international level.

The students will have adequate exposure to the required instruments and hands-on training.

The students will acquire the necessary expertise to enter the expanding food and nutraceutical industries.

The students will have a mindset of entrepreneurship to ensure that they have the incentive to establish businesses of their own.

PROGRAMME OUTCOMES (PO)

MASTERS IN SCIENCE (MSc)

Postgraduate Science Program Outcomes:

PO1	**Advanced Understanding:** Attain an advanced understanding of specialized scientific areas and theories, building upon undergraduate knowledge.
PO2	**Advanced Analytical Skills:** Develop advanced analytical and problem-solving skills for complex scientific issues.
PO3	**Research Proficiency:** Acquire proficiency in scientific research, contributing significantly to the advancement of knowledge.
PO4	**Leadership Skills:** Develop leadership skills to lead scientific initiatives and contribute to the scientific community.
PO5	**Interdisciplinary Collaboration:** Collaborate effectively with interdisciplinary teams for comprehensive scientific solutions.
PO6	**Innovation and Creativity:** Foster innovation and creativity in scientific research and practice.
PO7	**Professionalism:** Demonstrate professionalism and excellence in all scientific endeavors.
PO8	**Quality Improvement:** Embrace self-evaluation and continuous improvement for achieving excellence in scientific pursuits.

Programme: MSc Nutraceuticals

Programme Specific Outcomes (PSOs) for MSc in Nutraceuticals

Sr. No.	A student completing M.Sc. in Nutraceuticals will be able to:
PSO 1	Demonstrate a systematic understanding of the fundamental concepts. Principles and processes in the field of Nutraceuticals and food technology.
PSO 2	Exhibit technical competence for verifying the organoleptic (Sensory), hygienic, and nutritional quality of foods using innovative methods.
PSO 3	Recognize, report, examine and solve multiple technical and organizational problems of food sector applying sustainable solutions to real world problems and develop technical knowledge to start up a food business.
PSO 4	Evaluate current issues and developments related to the nutrition discipline and propose/develop new insights applying knowledge and technology for development of safe nutritious and high-quality food products.
PSO 5	Acquire a deep scientific knowledge regarding the chemical and microbial characteristics, nutritive and functional properties, processing, preservation, packaging, engineering, and quality control technology of various food items
PSO 6	Able to contribute trained human resource with the sound knowledge and skills in total quality management and regulatory affairs to work in industrial, academics, food, and health sectors.
PSO 7	Develop into vibrant and internationally competitive food technology and nutraceutical professionals with entrepreneurial skills.
PSO 8	Generate the ability to design, conduct research for solving both health/ nutritional and food safety problems of the society; contributing to the development of scientific and technical knowledge in food technology and nutraceutical.

M.Sc. Nutraceuticals

This two-years master's program in Nutraceuticals trains the students for all facets of Nutraceutical industry. It teaches them to choose the raw material, analyze its suitability based on its chemical profile, and trace of contaminants.

Use of different techniques gives them a way to manufacture Nutraceutical supplements without losing their nutritional values. An extensive knowledge about food laws, patents, consumer behavior makes them thorough about the sustainability and growth of these Nutraceuticals in the international market. The comprehensive syllabus gives the students a chance to understand the biochemistry of what we eat, how it gets metabolized and affects physiology, along with the dietary adjuvants under normal and disease conditions. Considering Man's age-old battle with Cancer, and the challenge of staying healthy with current lifestyle, it is a must one start looking into nutrition in a wiserway.

This program brings together the knowledge about food and nutrition from all disciplines of science. The practical training at different renowned industries also helps them to choose one aspect and excel in it. It is said, "What We Eat, We Become". Man has come a long way from being just an organism who feeds to survive, to the most dominant species on this planet. Man's ability to understand the link between different events and then apply this information for a better outcome is one prominent reason behind this progress. The M.Sc. Nutraceutical program offers an opportunity to get a glimpse of traditional Ayurveda and then make sense of its mode of action using modern technology. Being able to bridge these gaps will one day enable man to drive away diseases and have a healthy lifestyle based only on FOOD.

DISTRIBUTION OF CREDITS

SEMESTER I

Paper	Code	Lectures (h)	Credits earned	Code	Practical (h)	Credits earned
I: Basic Principle of Food Chemistry & Nutrition	GNKPSNTMJ1501	60	04	GNKPSNTMJ1P501	60	02
II: Nutraceutical & Functional Food	GNKPSNTMJ2501	60	04	GNKPSNTMJ2P501	60	02
III: Food Chemistry & Biochemistry	GNKPSNTMJ3501	30	02	-	-	-
Food Safety Laws & Regulations (Elective)	GNKPSNTEL1501	45	03	GNKPSNTEL1P501	30	01
IV: Research Methodology	GNKPSNTRM501	30	2+2=04		-	-

SEMESTER II

Paper	Code	Lectures (h)	Credits earned	Code	Practical (h)	Credits earned
I: Food Microbiology & Quality Process Control for Nutraceuticals	GNKPSNTMJ1502	60	04	GNKPSNTMJ1P502	60	02
II: Clinical Dietetics & Nutrigenomics	GNKPSNTMJ2502	60	04	GNKPSNTMJ2P502	60	02
III: Instrumentation & Biological Evaluation	GNKPSNTMJ3502	30	02	-	-	-
Public Health, Nutrition and New Product Development (Elective)	GNKPSNTEL1502	45	03	GNKPSNTEL1P502	30	01
On Job Training	GNKPSNTOJT502	60	04		-	-

Examination Pattern for First Year Post Graduate Degree for Science Faculty as per NEP 2020 Academic Year 2025-2026

Subject (SEM I & II)	Credits	Internal Evaluation (Marks	Semester End Examination (Marks)	Total
Mandatory paper- I	04	40	60	100
Mandatory paper-II	04	40	60	100
Mandatory paper-III	02	20	30	50
Practical-I	02	20	30	50
Practical-II	02	20	30	50
Elective-Theory	03	30	**45**	**75**
Elective-Practical	01	10	15	25
Research Methodology (RM)	02 + 02 = 04	50	50	100
			Grand Total	**550**

Please note: The internal evaluation will be at the departmental level.

- **Combined passing with minimum 20% in Internal Component.**
- **Mandatory paper will consist of 4 units, 15 lectures each.**
- **Elective theory paper will consist of 3 units, 15 lectures each.**
- **Practical - I shall consist of a minimum of 5/6 practicals.**
- **Practical - II shall consist of a minimum of 5/6 practicals.**
- **Elective practical paper shall consist of a minimum of 4 practicals.**
- **Research Methodology 04 credits = (02 credits at the departmental level and 02 credits at the Common Faculty level).**

For 2 credits at the departmental level the students can be evaluated for the following: literature survey, proposal writing, assignments, case study, review articles, paper presentation and writing etc.

SYLLABUS SUMMARY

Semester I	Credits	Semester II	Credits
GNKPSNTMJ1501: Basic Principle of Food Chemistry & Nutrition 1501.1 Carbohydrates, Vitamins & Minerals 1501.2 Lipids & Proteins: Chemistry & Metabolism 1501.3 Enzymes 1501.4 Nutritional requirements for Special Dietary Needs	**04**	**GNKPSNT1502: Food Microbiology & Quality Process control for Nutraceuticals** 1502.1 Basic Microbiology 1502.2 Principle of Food Processing & Preservation 1502.3 Fermentation Technology 1502.4 Downstream processing	**04**
GNKPSNTMJ1P501: Lab 1	**02**	**GNKPSNT1P502: Lab 1**	**02**
GNKPSNTMJ2501: Nutraceutical & Functional Food 2501.1 Introduction to Nutraceuticals, Functional Foods and Phytonutrients 2501.2 Nutraceutical as Remedies and Nutritional Factors 2501.3 Food Additives 2501.4 Food Analysis and Instrumentation	**04**	**GNKPSNT2502: Clinical Dietetics & Nutrigenomics** 2502.1 Bioinformatics-I 2502.2 Clinical Dietetics: I 2502.3 Clinical Dietetics: II 2502.4 Food Genomics and Nutritional Genomics	**04**
GNKPSNTMJ2P501: Lab 2	**02**	**GNKPSNT2P502: Lab 2**	**02**
GNKPSNTMJ3501: Food Chemistry & Biochemistry 3501.1 Nucleic Acids 3501.2 Endocrinology	**02**	**GNKPSNTMJ3502 Instrumentation & Biological Evaluation** 3502.1 Instrumentation 3502.2 Biological evaluation	**02**
GNKPSNTEL1501: Food Safety Laws & Regulations (Elective) 1501.1 Food Safety and Standard Act 1501.2 Food Regulations I 1501.3 Food Regulations II	**03**	**GNKPSNTEL1502: Public Health, Nutrition and New Product Development (Elective)** 1502.1 Public Health and Nutrition 1502.2 New Product Development 1502.3 Organoleptic responses	**03**
GNKPSNTEL1P501: Lab 3	**01**	**GNKPSNTEL1P502: Lab 3**	**01**
GNKPSNTRM4501: Research Methodology 4501.1 Research Methodology, Scientific Research and writing 4501.2 Biostatistics 4501.3 Research Fundamentals and Terminology 4501.4 Research Writing	**2+2= 04**	**GNKPSNTOJT4502: On Job Training**	**04**
Total	**22**		**22**

SEMESTER I

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper I: Basic Principle of Food Chemistry & Nutrition
Paper Code: GNKPSNTMJ1501
Credits: 04
No of Lecture: 60
Marks: 100 (60+40)

Learning objectives:
The course will enable the students to:

- To understand the fundamentals of carbohydrates, vitamins, and minerals with their importance in metabolism.
- To understand the fundamentals of lipids and proteins with their role in biological system.
- To understand the basic concept and terminology of Nutrition.
- To study the special Dietary requirements for specific group of population.

Learning Outcome:

- Describe the structure and functions of major macro and micronutrients.
- Elucidate the chemistry underlying the properties, structure and function of macro and micronutrients in the biological system.
- To have knowledge of different terminology and its role in Food & Nutrition.
- Describe the basic dietary needs for specific population.

Unit	Subunit	Title	No. Of lectures
1501	**1501.1**	**Carbohydrates, Vitamins & Minerals**	**15**
		Carbohydrates: Digestion & absorption, Structure, Classification, physical, chemical, nutritional, and functional properties, metabolism of carbs, role of sugars and polysaccharides in food industry. FODMAP (Fermentable Oligo, Di, Monosaccharides, and polyols). Dietary fibres – Soluble and Insoluble health benefits and its role in control of disease conditions and impact of excess fibre, Examples such as Inulin and Resistant starch.	
		Vitamins: Source & functions of vitamins, classification, and properties of water- and fat-soluble vitamins, bioavailability & deficiencies.	
		Minerals: Nutritional aspects of minerals, sources, functions, deficiency disorders, bioavailability, deficiencies & role of minerals in food.	
	1501.2	**Lipids & Proteins: Chemistry & Metabolism**	**15**
		Lipids: Classification of lipids, Fatty acids, Essential fatty acids, Triacylglycerols, Phospholipids, Digestion, Mobilization and transport of fats, Cholesterol synthesis, Beta Oxidation and Ketone body synthesis.	

		Proteins: Amino acids - Essential and nonessential amino acids, Structure of proteins, protein denaturation and denaturing agents, Properties of protein, digestion, and absorption of proteins Classification of Protein. Urea cycle, Methods of evaluating protein quality.	
	1501.3	**Enzymes**	**15**
		Enzymes: Nomenclature and classification Chemical nature and properties of enzymes, Factors affecting enzyme activity, Enzyme inhibition, Mechanism of enzyme action, Enzyme specificity, Isoenzymes. Enzymes in food processing industry, permissible range of Enzymes as per the Regulations. GM & Non- GM Enzymes with examples.	
	1501.4	**Nutritional requirements for Special Dietary Needs**	**15**
		Basics of energy balance - Basal Metabolic Rate (BMR), Body Mass Index (BMI) and Specific Dynamic Action (SDA/ thermic effect), recommended dietary intake, acceptable dietary intake. Balanced Diet, Glycemic index, Bioavailability, Assessment of nutritional status. Protein Energy Malnutrition (PEM). Nutritional requirements for different types of physical activities and sports (athletes). Nutritional requirements of infants Nutritional requirements of pregnant women Nutritional requirements of lactating women Nutritional requirements of geriatrics	

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper II: Nutraceutical & Functional Food
Paper Code: GNKPSNTMJ2501
Credits: 04
No of Lecture: 60
Marks: 100 (60+40)

Learning objectives:
The course will enable the students to:

- To learn about the various nutraceutical molecules and their application in functional food.
- To learn about the permitted food additives in accordance with food regulations.
- To understand the functionality of sweeteners and flavouring agents as additives
- To understand the different sampling techniques, basic measurements, and standardization protocols for food analysis.
- To comprehend the use of spectroscopic techniques for food analysis

Learning Outcome:

- Ability to collect sample, calibrate instruments and measure food quality parameters properly.
- knowledge of novel techniques and their application in food industry.
- The ability to understand the functionality of bioactive compounds.
- To be able to use pre and probiotics for health food products.
- To be able to employ food additives in processed food products.
- To be able to employ sweeteners and flavouring agents as food additives.

Unit	Subunit	Title	No. Of lectures
2501	**2501.1**	**Introduction to Nutraceuticals, Functional Foods and Phytonutrients**	**15**
		Introduction to functional foods and nutraceuticals, Classification of nutraceuticals based on source and chemical nature. Concept of antioxidants	
		Nutraceuticals of plant origin: Plant secondary metabolites- Terpenoids, Phenolics, Alkaloids, phytoestrogens, Pigments, Organ sulphur compounds. Sources and health benefits of nutraceuticals: Glucans, ascorbic acid, quercetin, kaempferol, rutin, β-carotene, allicin, lycopene, limonene, α-tocopherol, zeaxanthin, caffeine, Olive oil, green tea.	
		Nutraceuticals of animal origin: Sources and health benefits of nutraceuticals - chitin, chitosan, glucosamine, chondroitin sulphate, conjugated linoleic acid, eicosatetraenoic acid, docosahexaenoic acid, choline, lecithin	
	2501.2	**Nutraceutical as Remedies and Nutritional Factors**	**15**
		Nutraceuticals in treatment for cognitive health Eye health, Respiratory disorder, Digestive disorder Circulatory problems, Kidney disorder, Liver disorder, Reproductive disorder, Skin problems and Bone health	
		General idea about role of Probiotics, symbiotic & postbiotics.	
		Types of Inhibitors present in various foods. Negative impact of excess phytonutrients	
	2501.3	**Food additives**	**15**
		Definitions, classification, and functions, need for food additives, food preservatives, antimicrobial agents (types, mode of action and their application) Antioxidants, Sequestrants, Surface active agents Stabilizers, Thickeners, raising agents Bleaching. and Maturing agents, sweeteners, fat replacers, acid regulators Food colour and flavour: Natural and synthetic, types, properties, Applications, regulatory aspects and safety issues.	

	2501.4	**Food Analysis and Instrumentation**	**15**
		Proximate Analysis of food items for calorific value, protein, carbohydrates, vitamins, minerals, fibre contents.	
		Spectroscopy: Basic concepts, Beer-Lambert law & brief description of colorimetry, UV–VIS Spectroscopy, FTIR	

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper III: Food Chemistry & Biochemistry
Paper Code: GNKPSNTMJ3501
Credits: 02
No of Lecture: 30
Marks: 50 (30+20)

Learning Objectives:
Learning Outcomes:

Unit	Subunit	Title	No. Of lectures
3501	**3501.1**	**Nucleic Acid**	**15**
		Nucleic acid structure Structure and Forms of DNA RNA and it types DNA Replication Protein synthesis Gene regulation PCR methodology and application Nucleic acid sequencing Blotting techniques Molecular marker and its applications	
	3501.2	**Endocrinology**	**15**
		Classification of Hormones Mechanism of hormone action, second messengers Biosynthesis, transport and metabolic effects of hormones; Thyroid hormones, Hormones of adrenal, gonads and pancreas, Characteristics and hormone receptors (thyroid, adrenal, gonads)	

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper III: Food Safety Laws & Regulations (Elective)
Paper Code: GNKPSNTEL1501
Credits: 03
No of Lecture: 45
Marks: 75 (45+30)

Learning objectives:
The course will enable the students to:

- Understanding of laws and legal provisions for food in India
- Understanding of FSSAI standards and amendments.
- Understanding of quality parameters for food safety.

Learning Outcome:

- Regulatory based knowledge gain.
- Product development based on regulation, Regulatory affairs.
- Able to understand the importance of manufacturing guidelines and certifications.

3501	**3501.1**	**Food Safety and Standard Act:**	**15 L**
		General Principles and Mandate Structure and Implementation, Composition of Authority Important Definitions - Food Ingredient, Food Additive, Food Adulterant, Food Business Operator, Food Claim, Misbranded Food, Sub-standard Food, Unsafe Food, Food Safety Audit, Food Safety Management System (FSMS), Manufacturer, Manufacturer, Risk Analysis (Risk Assessment, Risk Management, Risk Communication) Update on FSSAI Regulations for Nutraceuticals. Prohibition & Restriction on Sales Regulations, 2011 Contaminants, Toxins & Residues Regulations, 2011 Laboratory & Sample Analysis Regulations, 2011 Proprietary Foods Amendments up till the current year.	
	3501.2	**Food Regulation I:**	**15 L**
		Section 22 – Requirements for New/Novel Foods – (Nutraceuticals, GMF, Organic Foods, Functional Foods, FSDU, FSMP, Proprietary Foods, etc.) Licensing and Registration of Food Business, Conditions of License, Approval & Renewal Process Food Import & Export Regulations Food Recall Procedures	
	3501.3	**Food Regulation II:**	**15 L**
		AGMARK Green Certification & Eco Labels Organic Certification Genetically Modified Foods (GMF), Genetically Engineered Foods (GEF) Mandatory BIS Certifications applicable to Foods	

		Introduction to ISO Standards – ISO 9000 Series – Quality Management, ISO 22000 Series – Food Safety Management International standards.	

M.Sc. Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper IV: Research Methodology
Paper Code: GNKPSNTRM501
Credits: 02 + 02
No of Lecture: 30 + 30
Marks: 50 +50 = 100

Learning objectives:
The course will enable the students to:

- To introduce the students to the basic concepts of research methodology and research process and develop a comprehension of the ethical dimensions of research.
- To introduce the students to principles of statistics and mathematics that apply to biomedical research.
- To familiarize the students to review and refer scientific literature and scientific writing and research presentation.

Learning Outcome:

- Apply the knowledge data collection and principles of statistical methods to collect and analyse biomedical data effectively.
- Apply the knowledge of scientific writing to effectively draft and publish good research reports.
- Define research and distinguish research activities from routine laboratory exercises and identify different types of research based on approaches, nature of data generated and applications.

Unit	Subunit	Title	No. Of lectures
4501	**4501.1**	**Research Methodology, Scientific Research, and writing**	**15**
		Computing skills for Scientific research- Web browsing for information search, Search engines and their mechanism of searching, Hidden web and its importance in scientific research Internet as a medium of interaction between scientists. Effective email strategy using the right tone and conciseness. Open-Source Databases, Use of AI like ChatGPT for Research or scientific writing. **Interpretation and Report writing:** Meaning, techniques, precautions of interpretation, significance of report writing. Report writing- steps, types, components of research. Report- title author, abstract, summary, synopsis, key words, introduction, Methods & materials, Result, discussion, acknowledgements, appendixes, references, plagiarism. Use of tables/ figures in report writing- need, introduction and placement of tables/ figure, numbering, box heading, caption photographs. Formatting and typing- introducing margins, spacing, alignment, fonts etc. Format of thesis, Word software- based index and bibliography input methods.	

	4501.2	**Biostatistics:**	**15**
		Biostatistics: General Account, Terms and Symbols used in Biostatistics, Methods of Sampling and Data Collection, Classification, Tabulation and Graphic Representation of Data, Measures of Central Tendency, Measure of Position- Quartile, Percentile, Measures of Dispersion- Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance. Types of Probability Normal, Binomial and Poisson distribution Tests of Significance -- Z- Test; Student t Test; The Chi-Square Test, ANOVA Types of Correlation; Properties of Coefficient of Correlation; Methods of Studying Correlation Regression Analysis; Kinds of Regression Analysis. Statistical tools for data analysis: SPSS, MS Excel, Minitab, Matlab Statistical approach for new product development: Response Surface Methodology	

Content for Research Methodology
Common PG courses (Science) (2 credits)

Units	Topic	Lectures	credits
4501.3	**Research Fundamentals and Terminology**	(07)	
	Meaning and Objective of research, features of a good research study, types of Research (qualitative and quantitative research) Study designs and variations: basic, applied, historical, exploratory, experimental, ex-post-facto, case study, diagnostic research, crossover design, case control design, cohort study design, multifactorial design		1
	Literature Survey Methods	(08)	
	Journal and abbreviation, current titles and review, monographs, textbooks, introduction to abstract, Beilstein, subject and author index Digital: Web sources, E-journals, Journal access, TOC alerts, Hot articles, Citation Index, Impact factor, H-index, E-consortium, UGC info net, E-books, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Sciurus, Google Scholar, Wiki-databases, Science Direct, SciFinder, Scopus.		
4501.4	**Research writing**	(10)	
	Scientific writing- Reporting practical and project work, writing literature surveys and reviews, organizing a poster display, giving an oral presentation. Writing Scientific Papers: Justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Project Proposal and research funding agencies, Research grants, scholarships and funding (CSIR, DBT, DST, DST- INSPIRE Fellowship, ICMR, INSA, BRNS, MoEFCC, UGC-RFSMS, Fulbright Fellowships for Indian students, Lady Tata Memorial Trust, EPA, Bill and Melinda Gates Foundation, Wellcome Trust, Erasmus Mundus)		1
	Publication ethics and Bibliography:	(05)	
	Publication ethics: definition, introduction Best practices/ Standards settings initiative and guidelines COPE, WAME Conflict of interest Publication Misconduct: definition, concept, problems that lead to unethical behaviour. Violation of publication ethics, authorship, and contributor ship Identification of publication misconduct Predatory publisher and journals Use of reference management software (MS Word / Zotero / Mendeley)		

SEMESTER I

PRACTICALS

Lab 1:
GNKPSNTMJ1P501

1. Estimation of crude fat contents of foods by Soxhlet's method.
2. Demonstration of total Nitrogen of foods by Kjeldahl and Micro Kjeldahl methods.
3. Estimation of protein by Biuret method.
4. Estimation of total carbohydrates using Anthrone method.
5. Reactions of mono, di and polysaccharides and their identification in unknown mixtures.
6. Determination of Moisture & Ash content of given food sample.
7. Identification of functional group using FTIR.
8. Design a Diet plan for specific conditions (Pregnancy, Lactation, Sportsperson, Infants and Elderly) w.r.t. Nutraceuticals.

Lab 2: GNKPSNTMJ2P501

1. Determination of Acid value of fats and oils.
2. Determination of Iodine number of fats and oils.
3. TLC separation of Plant bioactive compounds from given plant sample – Curcumin
4. To prepare plasmid DNA from given culture and its electrophoresis.
5. Extraction & estimation of inhibitors in food (eg. saponins, alkaloids, phytic acid, trypsin).
6. Qualitative estimation of phytochemicals
7. Estimation of Iron by dipyridyl method.
8. Study of a few IP monographs and their identification using characteristic features of nutraceutically important plants like *Phyllanthus emblica, Curcuma longa, Aloe barbadensis miller*.

Lab 3: GNKPSNTEL3P501 (ELECTIVE)

1. To propose an approach for a trouble shooting scenario (Minimum 2 case studies) Product recall.
2. Case Study on licensing or SOI (Statement of Ingredient)
3. Presentation on given topic

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35. R.C. Dubey, A Text book of Biotechnology, S.Chand, 2007.
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39. Gordon L. Robertson, food Packaging Principles and practice.
40. FSSAI Compendium and Drafts.
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44. James L. Summer,Dietary Supplement Labelling, compliance review 3rd edition.
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52. Mridula and Sreelata, Food science and processing and technology, Vol 2.
53. Timotht. S. Tracey and Richard L. Kingston, Herbal products.
54. Prof. P. H. Kulkarni, Ayurveda ahar. (Food/ diet).
55. Principal of Fermentation Technology – Whittaker and Stanbury.
56. Nutraceutical and Functional Food Regulations in the United States and around the world, Second edition, Debasis Bagchi, Elsevier Press.
57. Jean Richard Neeser and J. Bruce German, Bioprocesses and biotechnology for functional foods and Nutraceuticals, Marcel and Dekkar Publication.
58. Gunzler and Williams, Handbook of analytical techniques Vol 1.
59. Gunzler and Williams, Handbook of analytical techniques Vol 2.
60. Food safety and standard Act Rules and Regulations 2011, Akalank publication.

SEMESTER II

Paper	Code	Lectures (h)	Credits earned	Code	Practical (h)	Credits earned
I: Food Microbiology & Quality Process control for Nutraceuticals	GNKPSNTMJ 1502	60	04	GNKPSNTMJ 1P502	60	02
II: Clinical Dietetics & Nutrigenomics	GNKPSNTMJ 2502	60	04	GNKPSNTMJ 2P502	60	02
III: Instrumentation & Biological Evaluation	GNKPSNTMJ 3502	30	02	-	-	-
(Elective) Public Health, Nutrition & New Product Development	GNKPSNTEL 1502	45	03	GNKPSNTEL 1P502	30	01
On Job Training	GNKPSNT 4502	60	04		-	-

SEMESTER II

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper I: Food Microbiology & Quality Process control for Nutraceuticals
Paper Code: GNKPSNTMJ1502
Credits: 04
No of Lecture: 60
Marks: 100 (60+40)

Learning objectives:
The course will enable the students to:

- To understand basic microbiology.
- To comprehend basics of food spoilage with identification & detection of food contaminants.
  To understand the concept of fermentation and understanding of fermentation process, operation with knowledge of basic pathways of fermentative biochemical metabolic pathways.
  To understand the scientific and industrial processing of Indian fermentative product.
  To study the Product recovery, purification, and downstream processing of microbial fermented product.

Learning Outcome:

- To able to apply microbiology to food as well as to monitor food spoilage.
- To control microbiological hazards.
- Understand industrial or commercial fermentation concept, process troubleshoot process and decision-making.
- To be acquainted with the actual concept about application of fermentation technology.
  Have idea of the techniques used for product formulation.

Unit	Subunit	Title	No. Of lectures
1502	**1502.1**	**Basic Microbiology**	**15L**
		Morphology and Physiology of bacteria, Yeast Mold and protozoa Bacterial anatomy, Bacterial nutrition, Culture media, Growth Curve Microscopic techniques, Sterilization, and disinfectant – Physical and Chemical Sterilization Laboratory set up for microbiological testing Microbiological testing for nutraceuticals. Emerging new models for testing the claims and Safety tests	
	1502.2	**Principle of Food Processing & Preservation**	**15L**
		Water: Functions and significance of water Solution interactions, Water activity, Osmolarity, Relation between viscosity and temperature; Acid, base, and ph. Food stability: freezing, spray drying lyophilization, Air drying and shelf life. Food Spoilage: Contamination and microbial spoilage of various food products, Food borne infections and intoxications. Food Preservation: Role & Effect of radiation in food preservation, Traditional methods of Food Preservation, Retort Technology.	

	1502.3	**Fermentation Technology:**	**15L**
		Fermentation: Definition, set-up and outline of the typical bioprocess working, Fermenter design. Media for microbial fermentation. Submerged and surface fermentation, Bioreactor designs and types of bioreactors, process parameters, Sterility and contamination control, Factors affecting production: Aeration, agitation and oxygen uptake Products of microbial fermentations: Yeast, Vinegar, Prebiotics, Probiotics, Antioxidants, PUFA, Vitamins, Arachidonic acid, γ- Linoleic acid Cheese,	
	1502.4	**Downstream processing:**	**15 L**
		Product recovery and downstream processing, Separation techniques, Centrifugation, precipitation, Purification processes like chromatographic techniques ultra-filtration, ion exchange, Tangential flow filtration, micro and nanofiltration techniques, reverse osmosis, etc.Heat transfer mechanisms, Mass transfer operations: drying, evaporation, concentration, dehydration technique., Solvent extraction, Filter pressing operation, Crystallization, Micronization,	

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper II: Clinical Dietetics & Nutrigenomics
Paper Code: GNKPSNTMJ2502
Credits: 04
No of Lecture: 60
Marks: 100 (60+40)

Learning objectives:
The course will enable the students to:

- To understand the role and importance of Phytonutrients.
- To be acquainted with the knowledge of nutritional needs in Health & Disease
- To understand how nutrients modulates genome expression.

Learning Outcome:

- Elucidate the underlying properties of various phytonutrients
- Able to prepare diet plans by the knowledge of nutritional requirements for different physiological conditions.
- Ability to understand nutrients effect on gene expression as a molecular signalling target.

Unit	Subunit	Title	No. Of lectures
2502	**2502.1**	**Bioinformatics-I:**	**15L**
		What is Bioinformatics? History, Database and Importance, application, challenges and opportunities of Bioinformatics. Introduction to sequence alignment: Pairwise and multiple. Sequencing development; Tools in Bioinformatics: Predict amino acid sequence to protein design & interaction. Proteomics	
	2502.2	**Clinical Dietetics: I**	**15L**
		Nutritional requirement in weight loss, obesity, Hypertension, Cardiovascular disease, Diabetes Mellitus, Disorders of reproductive system: Polycystic ovary syndrome (PCOS), Rheumatoid Arthritis & Asthma	
	2502.3	**Clinical Dietetics: II**	**15L**
		Nutritional requirement in GI disease (Peptic Ulcers, Renal Disease (CKD), Respiratory illness (COPD), AIDS, Cancer Effect of food nutrients & nutritional status in drug dosage & efficacy.	
	2502.4	**Food Genomics and Nutritional Genomics**	**15L**
		Definition and terms Nutrigenomics, Benefits of Nutrigenomics, Technologies involved in nutrigenomics, Nutrients modulating genome expression, Concept of Nutrigenetics for lactose intolerance, diabetes and cancer. Foodomics, The added value of foodomics in the food industry, Personalized nutrition. Plants as an alternative for biotransformation of raw materials into special chemicals. Plants as 'bioreactors' as a tool for production of Nutraceuticals.	

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper III: Instrumentation & Biological Evaluation
Paper Code: GNKPSNTMJ3502
Credits: 02
No of Lecture: 30
Marks: 50 (30+20)
Learning Objectives:
Learning Outcomes:

Unit	Subunit	Title	No. Of lectures
3502	3502.1	**Instrumentation**	**15**
		Chromatography: TLC, HPTLC, HPLC, GC & MS. Validation protocols and concepts of standards, linearities, result interpretation, trouble shooting **Electrophoresis:** Zonal, paper, gel electrophoresis and isoelectric focusing and their application.	
	3502.2	**Biological evaluation:**	
		Antigen-Antibody reaction Radioimmunoassay (RIA) ELISA Immunoflorescence Coomb's & Gell,s Classification Type I, II, III & IV hypersensitivity mechanism Food allergens and allergenicity	**15**

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper III: Public Health, Nutrition and New Product Development (Elective)
Paper Code: GNKPSNTEL1502
Credits: 03
No of Lecture: 45
Marks: 60

Learning objectives:
The course will enable the students to:

- To understand the importance of new product development with novel food ingredients
- To understand the role of organoleptic evaluation in product development & to learn various test for food.

Learning Outcome:

- Knowledge to develop a novel product development in Nutraceuticals using NPD Life cycle
- Students will have idea of the techniques used for product formulation.

Unit	Subunit	Title	No. Of lectures
1502	**1502.1**	**Public Health and Nutrition**	**15L**
		Introduction to PHN – Definition, scope & importance. Nutritional deficiencies and public health concerns, Growth charts. Role of macro & micronutrients in population health. Food Security, Global and national food security challenges and initiatives, Socioeconomic determinants of nutrition and health disparities, Nutrition programs & policies (eg. ICDS, Mid-Day Meal Scheme, POSHAN Abhiyan). Fortification & supplementation programs, Monitoring & evaluation of nutrition programs, Ethical considerations in public health nutrition policies.	
	1502.2	**New Product Development**	**15L**
		NPD Cycle: Idea generation and screening, concept development and testing, Choice of target population & procurement of raw materials. Product development, marketing strategy and product launching.	
	1502.3	**Organoleptic responses**	**15L**
		What is Sensory Evaluation – Definition & Scope, Role of Sensory Evaluation as an Aid to Product Development and Quality Control. Basics of Organoleptic Responses pertaining to Food Sensory Evaluation – Vision, Touch, Smell, Taste. Food Sensory Evaluation – General Guidelines for Setting up of Panels, Preparation of Samples and Conducting Sensory Study. Food Sensory Attributes (Colour, Texture, Viscosity, Consistency, Odour, Aroma, Flavor, etc.) & Sensory Analysis Vocabulary. Types of Sensory Panels and Guidelines for Setting up the same -Trained Panels [Laboratory Panels], Semi-trained Panels [Discriminative & Communicative (D&C) Panels], Untrained Panels [Consumer Panels]. Types of Sensory Tests commonly used in Food Sensory Evaluation – Hedonics, Triangle Test, Duo-Trio Test, A-not- A Test, 2-out of-5 Test.	

SEMESTER II

PRACTICALS

Lab 1:
GNKPSNTMJ1P502

1. Enzymatic browning and its control in fruits.
2. a. Preparation of prebiotics / probiotics using microorganisms and b. Viability study of probiotics
3. Lab scale preparation of fermented product: Kombucha tea, kimchi, sauerkraut
4. Extraction, purification, and evaluation of activity of any one digestive enzyme (e.g., Beta amylase from sweet potato.)
5. Estimation of Total bacterial count by viable count method
6. To separate the Milk proteins on Native and SDS gels.
7. Extraction and estimation of Lycopene.
8. Estimation of total phenols in plant materials.
9. Separation and identification of amino acids by TLC from given food sample.

Lab 2: GNKPSNTMJ2P502

1. Estimation of Caffeine by using HPLC.
2. Estimation of volatile compounds using GC.
3. Extraction & Identification of Isoflavones using TLC.
4. Extraction and estimation of piperine from pepper by using HPTLC.
5. Identification & adulteration of food
6. Estimation of antioxidant property of phytochemicals by DPPH
7. Bioinformatics – Study of search tools (FASTA, BLAST)
8. Detection of food allergen (eg. peanut allergen) in food products using ELISA.

Lab 3: GNKPSNTEL1P502 (ELECTIVE)

1. Organoleptic and Sensory Evaluation.
2. A research paper or review article must be published in a journal with good impact factor. (Credits will be given)
3. Preparation of Certificate of Analysis
4. Stability and shelf-life study.
5. Students must submit a Report of the Industrial Visits and a Field Notebook of their Visits.

M.Sc Nutraceuticals: 2025-26
Course Title: Nutraceuticals
Paper Code: GNKPSNTOJT4502
Credits: 04
No of Hours: 60
Marks:100

ON JOB TRAINING (OJT): GNKPSNTOJT4502

The students must attend ON JOB TRAINING (OJT) for industrial training/ project work/ product development of 8 to 12 weeks period. Project must involve application of knowledge and skills as prescribed in the syllabus and data evaluation must involve application of biostatistics (OJT)

OJT assessment will be done on following points

1. Presentation based on OJT
2. Submission of report based on OJT
3. Attendance in industry (Min 80%) & certificate of student

Reference:

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2. U. Satyanarayan, U. Chakrapani, Biochemistry, Uppala Author- Publisher Interlinks, 3rd Edition.
3. David L. Nelson and Michael M. Cox, Lehninger Principles of Biochemistry, 4th edition.
4. Peter J. Russell, iGenetics A molecular approach, Pearson, 3rd edition.
5. Modern Nutrition in health and disease by Goodhearth R., S. Shills.
6. Krause's Food, Nutrition and Diet Therapy, 12th Edition by Mahan, L.K. & Ecott- Stump, S. (2000), W.B. Saunders Ltd.
7. B. Srilakshmi, Dietetics, New Age International Publishers, 7th Edition.
8. Gerard J. Tortora, Bryan Derrickson, Principles of Anatomy and Physiology, John Wiley & Sons, 2009, 12th Edition.
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11. Geoffrey P. Webb, Dieatry Supplements and Functional Foods, Blackwell Publishing, 2006.
12. Yashwant Pathak, Handbook of Nutraceuticals, Volume 1, CRC Press, 2010.
13. Instrumental analysis, Skoog, Holler, Crouch Brooks/Cole, 2007.
14. Chromatography: Liquid Chromatography, Mass Spectrometry, W M A Niesson, 2nd and 3rd Ed.
15. HPLC Quantitative Analysis of Pharmaceutical Formulations-Dr. P D Sethi
16. HPTLC (High Performance Thin Layer Chromatography)-Dr. P D Sethi
17. Khan and Khanum, Fundamentals of Biostatistics, Ukaaz Publications.
18. Keith Wilson and John Walker, Principle and Techniques of Biochemistry and Molecular Biology.
19. G.A.F. Hendry, J.D. Houghton, Natural Food Colorants, Blackie and Son Ltd.
20. Voilley and Etievant, Flavor in Food,Woodhead Publishing Ltd, 2006.
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24. Benny K-H Tan, Boon-Huat Bay, Yi-Zhun Zhu, Novel Compounds from Natural Products in the New Millennium.
25. Israel Goldberg, Functional Foods (Designer Foods, Pharmafoods, Nutraceuticals), Aspen publication, 1999.
26. John Shi, Functional Food Ingredients and Nutraceuticals processing technologies, Taylor and francis.
27. Dhan Prakash and Girish Sharma, Phytochemical of Nutraceutical Importance.
28. Gillian Eggleston and Gregory L. Cote, Oligosaccharides in Food and Agriculture.
29. Keith Wilson and John Walker, Principle and Techniques of Biochemistry and Molecular Biology.
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31. Spectroscopy for Biological Science. -HAMMES.
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51. N, Shakuntalamanay, Foods: Facts and principles, New Age International Publisher.
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57. Jean Richard Neeser and J. Bruce German, Bioprocesses and biotechnology for functional foods and Nutraceuticals, Marcel and Dekkar Publication.
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59. Gunzler and Williams, Handbook of analytical techniques Vol 2.
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Shiromani Gurudwara Prabandhak Committee's

Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)

Matunga, Mumbai – 400 019, Maharashtra

Program: Master of Science

Syllabus

Course: MSc-II Nutraceuticals

Semester III and IV

(As per NEP guidelines-DSC model)

With effect from Academic Year 2025 - 2026)

Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)

Program Structure

Semester-III

Course Code	Course Name	Teaching Hours		Credits Assigned		
		Theory	**Practical**	**Theory**	**Practical**	**Total**
GNKPSNTMJ1503	(Major) Paper-I	60	60	4	2	6
GNKPSNTMJ2503	(Major) Paper-II	60	60	4	2	6
GNKPSNTEL1503	(Elective) Paper	45	30	3	1	4
GNKPSNTRP503	**Research project (RP)**	**--**	**--**	**--**	**--**	**6**
Total		**195**	**150**	**11**	**05**	**22**

Semester-IV

Course Code	Course Name	Teaching Hours		Credits Assigned		
		Theory	**Practical**	**Theory**	**Practical**	**Total**
GNKPSNTMJ1504	(Major) Paper-I	60	60	4	2	6
GNKPSNTMJ2504	(Major) Paper-II	60	60	4	2	6
GNKPSNTEL1504	(Elective) Paper	45	30	3	1	4
GNKPSNTRP504	Research project (RP)	--	--	--	--	6
Total		**165**	**150**	**11**	**05**	**22**

Examination Pattern for Second Year Post Graduate Degree for Science Faculty as per NEP 2020 Academic Year 2024-2025

Subject (SEM 3 & 4)	Credits	Internal Evaluation (Marks	Semester End Examination (Marks)	Total
Mandatory paper- I	04	40	60	100
Mandatory paper-II	04	40	60	100
Practical-I	02	20	30	50
Practical-II	02	20	30	50
Elective-Theory	03	30	**45**	75
Elective-Practical	01	10	15	25
Research Project (RP)	04 + 02 = 06	50	100	150
			Grand Total	**550**

Please note: The internal evaluation will be at the departmental level.

- **Combined passing with minimum 20% in Internal Component.**
- **Mandatory paper will consist of 4 units, 15 lectures each.**
- **Elective theory paper will consist of 3 units, 15 lectures each.**
- **Practical - I shall consist of a minimum of 5/6 practicals.**
- **Practical - II shall consist of a minimum of 5/6 practicals.**
- **Elective practical paper shall consist of a minimum of 4 practicals.**
- **Research Project 06 credits = (02 credits at the departmental level and 02 credits at External level).**

For 2 credits at the departmental level the students can be evaluated for the following: Overall performance throughout the projects, Paper writing (Manuscript) for the appropriate Journal, Finished Product with presentation/Licensing of Product .

SYLLABUS SUMMARY

Semester III	Credits	Semester IV	Credits
GNKPSNTMJ1503: Food safety, Quality and process Control 1503.1 Medicinal Plants: Ethnomedicine in India 1503.2 Quality Control and Quality Assurance 1503.3 Auditing, Certifications and Accreditation. 1503.4 Chemoprevention and Nutraceuticals	**04**	**GNKPSNTMJ1504: Food Safety, Hygiene and Quality Management of Nutraceuticals** 1504.1 Chemoinformatic & Pharmainformatics 1504.2 Global Food control system 1504.3 Food Sanitation & Hygiene 1504.4 Clinicals Trials of Nutraceuticals and health food, Basic Toxicology, Acute Toxicity studies with reference to Nutraceuticals	**04**
GNKPSNTMJ1P503: Lab 1	**02**	**GNKPSNTMJ1P504: Lab 1**	**02**
GNKPSNTMJ2503: Development & Marketing of Nutraceuticals and Functional Food 2503.1 Application of techniques in development of Nutraceuticals and functional foods 2503.2 Manufacturing and processing of Nutraceutical Products 2503.3 The role of marketing Communication in the introduction of functional foods to the Consumer 2503.4 Consumers' views on nutraceuticals	**04**	**GNKPSNTMJ2504: Entrepreneurship skills for Nutraceuticals/Food Industry** 2504.1 Introduction to Entrepreneurship 2504.2 Financial Management 2504.3 Marketing Management I 2504.4 Marketing Management II	**04**
GNKPSNTMJ2P503: Lab 2	**02**	**GNKPSNTMJ2P504: Lab 2**	**02**
GNKPSNTEL1503: Food Packaging, Labelling, Claims & Advertisements (Elective) 1503.1 Packaging strategies for Nutraceutical products- I 1503.2 Packaging strategies for nutraceutical products- II 1503.3 Labelling, Claims and Advertisement	**03**	**GNKPSNTEL1504: Intellectual Property Rights & Soft skills (Elective)** 1504.1 Introduction to IPR 1504.2 Registration of IPRs 1504.3 Soft Skills	**03**
GNKPSNTEL1P503: Lab 3	**01**	**GNKPSNTEL1P504: Lab 3**	**01**
GNKPSNTRP503: Research Proposal	**04**	**GNKPSNTRP504: Research Project**	**06**
Total	**22**		**22**

Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Nutraceuticals

Course: MSc-II Nutraceuticals
Semester-III
Course Title: Paper I: Food safety, Quality and process Control
Course Code: GNKPSNTMJ1503
Credits: 04
No of lectures (Hours): 60
Marks: 100 (60+40)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To understand the concept of Classical System of medicine A, S, U
2	To understand the relationship between Good Manufacturing Practices and Quality Control with Hazard Analysis.
3	To understand the importance of National and International Food Regulations.
4	To study about chemoprevention and nutraceuticals as remedy
5	To study regulatory concept on herbal preparation and Drug & Cosmetic Act for product development

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand and develop the method of manufacturing of a pharmaceutical / nutraceutical product.	1,2,5	1,3,8	C, U, Ap
CO 2	Evaluate & Compare National and International regulations of the Food and Nutraceutical Industry.	3,7	3,4,7	U, Ap
CO 3	Understand the importance of guidelines and certification and apply for product development	1,2,8	5,6	U, Ap
CO 4	Identify and analyse the critical quality control point in different stages of production of food and thereby designing the HACCP system.	2,5	5,8	An, C
CO 5	Explain & analyse the role, standard and law set by Indian and global regulatory authorities with respect to food quality control	3,4	3,4,5	Ap, An, E
CO 6	Understand, analyse, and formulate a chemo preventive nutraceutical product	3,6	1,7,8	U, An, Ap

Unit		Tit le	No. of lectures	CO Mapping
Unit 1	**1503.1**	**Medicinal Plants: Ethnomedicine in India**	**15**	
		Traditional Herb for Healthcare and Management of HumanDiseases, Addition to Classical System of medicine A, S, U.Basic concepts, type of drug formulations, Procurement ofherbal raw materials Method of preparation Preservation andstorage of herbal material, Standardization QC for medicinalplants, Regulatory aspects from Drugs & cosmetic act 1940 **Manufacturing Operations in Nutraceuticals:** Processing techniques for nutraceutical ingredients to be obtained from leaves, flowers, bark/stem, fruits, seeds and animal tissue.		**1**
Unit 2	**1503.2**	**Quality Control and Quality Assurance**	**15**	
		Introduction, what is QC? Introduction to manufacturing pharmaceuticals / Nutraceutical product and role of various department Defining and understanding concept of QC and QA, 10 pillars approach to working of QA. Preparation and Implementation of QA, QC including concept of TQM, Quality management principles and responsibilities of QA personal, GMP, cGMP and its applicability to nutraceuticals, validation, verification, and qualification Interrelationship between QA & QC Annual product quality review (APQR), Handling of complaints and product recall.		**2,4,5**
Unit 3	**1503.3**	**Auditing, Certifications and Accreditation.**	**15**	
		Audits: Food Safety and Quality Audit, Audit plan, Checklist, Auditor Competence, Audit exercise and post audit activities: Report writing, verification of corrective action and follow up. NABL Accreditation, overview andrequirement of ISO 17025, Requirements specific to foodtesting laboratories- physical, chemical, and biological parameters.		**2,3,4,5**
Unit 4	**1503.4**	**Chemoprevention and Nutraceuticals:**	**15**	
		Introduction to chemoprevention Food components and foodin chemoprevention. Mechanism of carcinogenesis. Phase I & II enzymes involved in chemo prevention. Role of nutraceuticals in chemoprevention: carotenoids, vitamin A and retinoids, selenium, polyphenols, Role of NFkβ, AP-1 Role of three functional categories from dietary components as chemopreventive agents: inhibitors of carcinogen exposure, anti-initiating/blocking agents, anti-promotional / progressive or suppressing agents		**6**

References:

- Timotht. S. Tracey and Richard L. Kingston, Herbal products.
- Prof. P. H. Kulkarni, Ayurveda ahar. (Food/ diet).
- Mridula and Sreelatha, Food science and processing and technology, Vol 2.
- R. B. Silverman (2004) The Organic Chemistry of Drug Design and Drug Action, 2nd Edition, Academic Press
- Investigating Biological System using Modeling: Strategies and software, Meryl E. Wastney 60. Dale G.Deutsch, Analytical Aspects of Drug Testing, John Wiley and Sons

Examination:

- **Internal Examination (25 Marks):** 20 Marks exam (Written Exam). And 5 Marks for Overall Conduct
- **End Semester theory examination (75 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2hours 30mins
- **Combined passing of 40% with minimum 20% in Internal Component.**

Practical Paper I
Course Title: Practical/ Paper I
Course Code:
GNKPSNTMJ1P503
Credits: 02
No of Practical (Hours): 60
Marks: 50 (30+20)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To explain the functional role and safety issues of food contaminants, food adulteration,
2	To describe the hygiene and sanitation in food processing plant, equipment, storage, and handling
3	To explain the various quality attributes of food and emphasizing on microbial quality control in food and water quality
4	To identify and analyse the critical quality control point in different stages of production of food and thereby designing the HACCP system
5	To interpret the role, standard and law set by Indian and global regulatory authorities with respect to food quality control
6	To enable the students to understand opening and closing of Audit plans

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Develop skills for presentation and writing scientific documents.	2,3,6	1,3	U, An, Ap
CO 2	Evaluate establishments based on the hygienic and consumer-acceptable qualities.	4,7	2,3	E, Ap
CO 3	Understand opening and closing of Audit plans (GMP, Quality audits) and make standard protocols based on the Government approved gazettes to prepare report on case studies on complaints and product recall.	1,5,7	3,4,5	U, An, Ap, C
CO 4	Identify and analyse the critical quality control point in different stages of production of food and thereby designing the HACCP system.	2,3,8	3,5,6	U, E, C Ap
CO 5	Evaluate the equipment, storage, handling, and hygiene and sanitation conditions in the food processing facility.	1,8	1,5	E, An
CO 6	Identify and compare the regulations established globally by India Vs other countries.	1,5,7	1,2	U, An, Ap
CO 7	Identify and analyse Nutraceutical industry in India and abroad based on R&D, Patents, Certifications and Collaboration.	5,7	1,4	R, U, An
CO 8	Understand and apply the analytical approach towards quality control.	1,2,3	1	R, U, Ap

References:

- Environmental regulation and food safety by Veena Jha.
- Jay, J.M. (1998). The HACCP System and Food Safety. In: Modern Food Microbiology. Food Science Texts Series. Springer, Boston, MA.Food safety by Laura K Egendorf, 2000
- International standards of food safety by Naomi Rees, David Watson, 2000
- Codex alimentarius by FAO & WHO, 2007
- Griepink B, Stoeppler M (1992) Quality assurance and validation of results

Course: MSc-II Nutraceuticals
Semester-III
Paper II: Development & Marketing of Nutraceuticals and Functional Food
Course Title: Nutraceuticals
Course Code:
GNKPSNTMJ2503
Credits: 4
No of lectures (Hours): 60
Marks: 100 (60+40)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To learn different techniques to enhance production and properties of nutraceutical products.
2	To work with the tools for capturing consumer voice & understanding consumer view as well as translating them into product design
3	To acquaint students with different formulation processing w.r.t. Nutraceuticals. To provide students with the basic practical skills required to prepare nutraceuticals in the form of powder, premix, capsule, tablets & syrup.
4	To develop the capacity of students to integrate knowledge and to analyse, evaluate and manage specific processing techniques used for various food products.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand & implement the role of media as an effective tool for communicating with the consumer.	1,7	7,8	U, Ap
CO 2	Design & apply the knowledge of marketing as well consumers survey to design a product	2,6	6,7,8	U, An, Ap
CO 3	Gain an overview of international laws and regulations pertaining to the safety of nutraceuticals, including regulations in the United States (DSHEA), Europe (EFSA), Japan (FOSHU and FNFC), Canada, and China.	1,6,5	4,6,7	R, Ap, E
CO4	Formulate a nutraceutical (in the form of powder, premix, capsule, tablets & syrup) and competent with respect to the principles of food chemistry and processing.	2,6,7	1,2,5	An, Ap, C
CO5	Understand, develop/ formulate a nutraceutical product using different applications of techniques.	1,2,4	1,2,4,5	U, C, E

Unit		Title	No. of lectures	CO Mapping
Unit 1	**2503.1**	**Application of techniques in development of Nutraceuticals and functional foods:**	**15**	

		Supercritical fluid extraction technology Basics and application for extraction of nutraceuticals from various sources, Application of pressurized low polarity water extraction Membranes separation technology Distillation and dehydration technologies Application of bioprocess technology for production and enhancement of properties of nutraceuticals. Green processes, cloud point, ultrasound, microwave assisted extraction Microencapsulation, Enzyme immobilization		**5**
Unit 2	**2503.2**	**Manufacturing and processing of Nutraceutical Products:**	**15**	
		Introduction to Health supplement / Nutraceutical Processing, **Capsule processing (Hard& Soft gel):** Dispensing of raw material/ ingredients/ packing material, Sifting/ Sieving, Blending, Fill preparation and Gel Preparation, Suspension based fill preparation, Oil based Fill preparation Encapsulation. Preliminary analysis: Metal Detector, Empty capsule sorter/ Mini capsule sorter. Packaging & labelling. **Powder & Premix processing:** Dispensing of raw material/ ingredients/ packing material, sifting & blending, Preliminary analysis: Metal Detector/ magnetic grills, Packaging & labelling. **Liquid Processing:** Manufacturing of Syrup / Suspension and Oral liquids. Dispensing of raw material/ ingredients/ packing material, Sugar-dissolving, syrup manufacturing online filtration, vacuum transfer, homogenisation, mix of APIs, bottling and packaging, CIP. **Tablet Processing**: Dispensing of raw material/ ingredients/ packing material, sifting & blending, Compression, Coating, Packaging, and labelling.		**4 Books**
Unit 3	**2503.3**	**The role of marketing Communication in the introduction of functional foods to the Consumer:**	**15**	
		Introduction to marketing and consumer buying behaviour, food purchase habits of people. The basics of communication processes used to convey the message- written and oral Communication. Legislation and its impact on advertising and labelling of Nutraceuticals. How to communicate health claims for functional foods?		**1,2**
Unit 4	**2503.4**	**Consumers' views on nutraceuticals:**	**15**	
		Current Consumer understanding of Nutraceuticals. What are the barriers to acceptance by the Consumer? -Value added? Credibility? Ethical issues? Tools for capturing consumer voice & understanding consumer view as well as translating them into product design attribute - (CLT), (HUT), & (QFD) Traditional marketing v/s Digital marketing		**1,2**

References:

- Larry L. & Stephen W., Pharmaceutical Dosage Forms: Tablets; Vol 2, Rational Design and Formulation.
- Pharmacopeial Forum, Vol. 35(5), [Sept. – Oct. 2009].
- Harshal P. & Lalitha K., Pharmaceutical Product Development: A systematic approach.
- Karel Eckschlager, Klans Danzer, Information Theory in Analytical Chemistry, John Wiley, and Sons
- Principles of Protein structure, Schultz, G. E., and Schirmer, R. H. Dr. Shakti Sahi
- Emerging technologies; food process by Da-wen, 2005
- Jean Richard Neeser and J. Bruce German, Bioprocesses and biotechnology for functional foods and Nutraceuticals, Marcel and Dekkar Publication.
- REMINGTON - ESSENTIALS OF PHARMACEUTICS .
- LACHMAN - THEORY AND PRACTICE OF INDUSTRIAL PHARMACY

Examination:

- **Internal Examination (25 Marks):** 20 Marks exam (Written Exam). And 5 Marks for Overall Conduct
- **End Semester theory examination (75 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2hours 30mins
- **Combined passing of 40% with minimum 20% in Internal Component.**

Course: MSc Nutraceuticals Practical
Semester-III
Course Title: Practical Paper II
Course Code:
GNKPSNTMJ2P503
Credits: 02
No of Practical (Hours): 60
Marks: 50 (30+20)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To familiarize students with laboratory procedures required for determining. the microbiological safety of foods.
2	To practically acquaint students with the new nutraceutical trend, including its types, mechanisms of action, and manufacturing processes for specific types of nutraceuticals
3	To provide students with basic practical skills required to prepare health supplements/ Nutraceutical product in the form of tablets, capsules, premix and syrups.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Analyse and estimate foods for their nutritional content	1,3	2,4,5	An, E
CO 3	Applying the fundamental practical abilities needed to produce and assess food.	2,8	2,3,4	Ap, E
CO 4	Illustrate aspects of toxicity, clinical testing, and the development of nutraceutical products.	3,7	5,6	R, U
CO 5	Recognise and evaluate essential concepts of consumer and business buying behaviour.	1,3,8	3,8	U, E
CO 6	Analyse and construct the document that communicates the results of a scientific test done on nutraceutical products.	2,3,6	3,4,5	An, C
CO 7	Developed competence with the ability to formulate Nutraceutical product in various forms.	2,4,6	4,6,8	C, An

References:

- Bornemann, Torsten, and Christian Homburg (2011), Psychological Distance and the Dual Role of Price Journal of Consumer Research, 38 (3), 490-504
- Coulter, Keith S., and Robin A. Coulter (2007), "Distortion of Price Discount Perceptions: The Right Digit Effect Journal of Consumer Research, 34 (2), 162–173.
- Ron Kenett & Silvia Salini, Modern Analysis of Customer Surveys - with Applications using R.
- The Handbook of Marketing Research: Uses, Misuses, and Future Advances by Grover, Rajiv, and Marco Vriens.
- Marketing Research: Text and Cases, 2nd Edition.

Course: MSc-II Nutraceuticals
Semester-III
Paper III Elective: Food Packaging, Labelling, Claims & Advertisements (Elective)
Course Title: Nutraceuticals
Course Code:
GNKPSNTEL1503
Credits: 03
No of lectures (Hours): 45
Marks: 75 (45+30)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To train students regarding the general principles of packaging and shelf life.
2	To study the rigid containers used for food packaging
3	To develop an insight into problems associated with packaging of perishables and processed foods
4	Orientation to different packaging material with focus on special materials used for packaging
5	The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used.
6	This course will enable students to appreciate the application of scientific principles in the packaging of foods
7	To understand the impact of advertising and labelling of Nutraceuticals.
8	To deal with presentation of product with Labelling, Claims and Advertisement FSSAI

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Describe packaging of various food commodities	1,6	5,8	R, U
CO 2	Justify the role of food packaging as a method offood preservation	3,8	2,3,5	U, Ap
CO 3	Interpret the role of different packaging materials and their physico-chemical properties	3,5	3,5,8	An, E
CO 4	Develop the packaging materials suitable for newer processing techniques and its assessment for specific application.	2,7,8	2,4,6	U, An, Ap
CO 5	Explain and interpret various tests used in evaluating quality & safety of food packaging	1,3	2,4,5	C, Ap
CO 6	Design a label for food products based on foodanalysis and type of product	2,4,6	3,8	U, R, C

Unit		Tit le	No. of lectures	CO Mapping
Unit 1	**1503.1**	**Packaging strategies for Nutraceutical products- I**	**15**	
		Introduction to Packaging Uniqueness of Nutraceutical Packaging, Packaging Forms & their Significance PackagingMaterials (covering basic mfg. process, applications andsignificance) Paper, Paperboard and CFB Glass, Metals,Basic Polymer based material. Polymer based compositematerials, Ancillary. Mats, Package Material Testing Packaging Techniques- Canning, Vacuum packaging, Modified Atmospheric packaging, Controlled Atmospheric packaging, Aseptic packaging. Passive & Active packaging, Smart & intelligent Packaging, Shrink packaging, Biodegradable packaging, Compatibility & Migration Studies. Permeability.		**1,2,3**
Unit 2	**1503.2**	**Packaging strategies for nutraceutical products- II**	**15**	
		Water vapor Transmission Rate (WTR), Oxygen Transmission Rate (OTR), Deteriorative changes in foodstuffand packaging methods for prevention, shelf life of packagedfoodstuff, methods to extend shelf-life. Accelerated Shelf- Life Testing Packaging of Pharmaceutical, Packaging of Nutraceuticals Packaging Laws and regulatory compliance New Developments in Packaging.		**4,5**
Unit 3	**1503.3**	**Labelling, Claims and Advertisement**	**15**	
		Food Safety & Standards (Labelling & Display) Regulations2020. Food Safety and Standards (Advertising & Claims)Regulations 2018.		**6**

References:

- Chi-Tang Ho and Qun Yi Zheng, Quality Management of Nutraceuticals.
- Gordon L. Robertson, food Packaging Principles and practice.
- FSSAI, Manuals on food additives, Andree Voilley and Patrick Etievant, Flavours in Food, CRC Press.
- G.A.F Hendry, and J.D Houghton, natural food colorants. AVI Publications.
- Ralph Shapiro and Marcel Dekker, Nutrition Labelling Handbooks, 1995.
- James L. Summer,Dietary Supplement Labelling, compliance review 3rd edition.
- Aseptic processing and packaging of Particulate foods by Edward M. A .Willhoft.
- Food packaging and shelf life-A practical guide, Gordon L. Robertson, CRC Press/Taylor & Francis Group, 2009
- Packaging technologies of functional foods in Functional food ingredients and Nutraceuticals processing technologies John Shi (Ed.) CRC Taylor & Francis group, 2007.

Examination**:**

- **Internal Examination (25 Marks):** 20 Marks exam (Written exam). And 5 Marks for Overall Conduct
- **End Semester theory examination (75 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2hours 30mins
- **Combined passing of 40% with minimum 20% in Internal Component.**

Course: MSc Nutraceuticals Practical
Semester-III
Course Title: Elective Practical (Elective)
Course Code: GNKPSNTEL1P503
Credits: 01
No of Practical (Hours): 30
Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To train students regarding the general principles of packaging and shelf life.
2	To interpret the nutrition facts label.
3	To determine the percent daily value of foods
4	To analyse nutrient content claims on labels.
5	To understand the impact of advertising and labelling of Nutraceuticals

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Asses the criteria for selecting a packaging material for a specific application.	3,7,8	1,2,5	E
CO 2	Establish the concepts of quality evaluation and testing of packaging materials using accelerated shelf-life study.	1,2	2,6	U, An
CO 3	Analyse the packaging strategies with respect to the nutraceutical product in compliance with the packaging regulations.	3,5	6,8	An, E
CO 4	Design the product presentation using labelling, claims and advertisement (FSSAI)	2,6,7	4,6,8	R, C
CO 5	Develop and apply food labelling knowledge and competency in students.	1,2,6	3,5,7	C, Ap

References:

- Modern food packaging, Indian Institute of Packaging, 1998
- Profile on food packaging/C.F.T.R.I and Indian Institute of packaging, 1995.
- Food packaging and preservation by M.Malthlouthi, 1994
- Food and Packaging Interactions by Risch.S.H. 1991
- Handbook of Food Packaging by F.A. Paine and H.Y. Paine 1983
- Food Packaging Technology (Vol.1 & 2) by G. Bureau and J.L.Multon, 1996

RESEARCH PROPOSAL: Credits: 04 (GNKPSNTRP503)

The project Proposal should involve proposed project work/ product development of 8 to 12 weeks period. Project must involve application of knowledge and skills as prescribed in the syllabus and data evaluationmust involve application of biostatistics.

Students must submit a project Proposal report covering the work undertaken. The project report (including mentors report) and observations / data generated will be presented and defendedbefore the panel of examiners.

SEMESTER III

Lab 1: GNKPSNTMJ1P503

1. Assignment / Case study of 10 pillars approach to working of QA.
2. SOP writing for given instrument.
3. To propose and approach a troubleshooting scenario (Minimum 2 case studies) Audit, Complaints,
4. Case study on chemopreventive phytochemicals
5. Case study on QC
6. Study of a few IP monographs and their identification using characteristic features of nutraceutically important plants like *Zingiber officinale & Allium sativum.*
7. Calibration & Validation of Equipment's for NABL accreditation

Lab 2: GNKPSNTMJ2P503

1. To prepare a market survey report on Nutraceutical/functional food product based on SEC Classification
2. Case study on Consumer buying behaviour
3. Case study on Consumer Survey.
4. Make a report on Isolation techniques for nutraceuticals/ Functional foods
5. Write a report on Traditional marketing & digital marketing.
6. Identification of various nutraceutical & functional foods available in the market
7. Visit a Food & Food Processing Industry/Food testing Laboratory/Food Park/Winery/Research Institute

Lab 3: GNKPSNTEL1P503

1. Identification and comparative analysis of packaging materials used for the given product
2. Solving accelerated shelf-life packaging problems using case studies.
3. Design a Label for the given food product.
4. Estimation of MSG present in the food sample using HPTLC method
5. Solving problems based on WVTR, IMC, using Q10 formula.

Course: MSc-II Nutraceuticals
Semester-IV
Paper I: Food Safety, Hygiene and Quality Management of Nutraceuticals
Course Code: GNKPSNTMJ1504
Credits: 04
No of lectures (Hours): 60
Marks: 100 (60+40)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To characterize different type of food hazards, physical, chemical and biological in the industryand food service establishments
2	To help become skilled in systems for food safety surveillance
3	To be aware of the regulatory and statutory bodies in India and the world
4	To ensure processed food meets global standards
5	To understand the concept of Quality Control and Quality Assurance
6	To understand and impart knowledge of importance of food hygiene, sanitation,and safety during food processing unit.
7	To learn the concept of basic toxicology studies with reference to Nutraceuticals; conduct clinical trials wrt regulatory compliance.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments	2,3	1,2	R, U, Ap
CO 2	Awareness on regulatory and statutory bodies in India and the world	8	1	U, An, Ap
CO 3	Understand the importance of application of sanitation and hygiene in food industry	1,2	1,3	U, Ap,An
CO 4	Understand, identify, and apply good hygiene & sanitary practices and measure to improve industry quality standards	1,8	1,3,6	U, Ap, E
CO 5	Comprehend the importance of Good Manufacturing Practices (GMP) and current Good Manufacturing Practices (cGMP) in the context of nutraceuticals.	1,8	1	U, Ap
CO 6	Identify the requirements and factors involved in implementing QC in the production of food products and nutraceuticals.	2,8	1,4	U, Ap, E
CO 7	Apply the concept of Quality Control (QC) and its significance in the manufacturing of nutraceutical products	2	1,8	R, U, Ap

CO 8	Understand, analyse the principles of toxicology study in nutraceuticals. Develop a product by applying principle of clinical toxicology	1,3	1,2,4	R, U, Ap

Unit		Title	No. of lectures	CO Mapping
Unit 1	**1504.1**	**Chemoinformatic & Pharmainformatics**	**15**	
		Introduction to drug design & its steps Types of drug design & various methods Introduction to drug discovery and its steps Molecular docking, ADME approach for drug, Application of AI in drug design, Introduction to Cheminformatics and its various representation		
Unit 2	**1504.2**	**Global Food control system**	**15**	
		USFDA, EFSA Food Codex Alimentarius: Introduction, standards, codex of practice, guidelines and recommendations, applying codex. standards, Codex India, core functions of National Codex Contact Point, National Codex Committee of India. Introduction to Other International Standards setting Bodies: FAO, SQF: 1000, SQF: 2000., SQF 8.1, Food Standards Australia, New Zealand (FSANZ), New Zealand Food Safety Authority (NZFSA), BRC food and BRC IOP standards, Food standards Agency (UK), China and Japan.		**1,2**
Unit 3	**1504.3**	**Food Sanitation & Hygiene**	**15**	
		Sanitary practices and Good Manufacturing practices (GMPs) with reference to Codex, FSSAI, US FSMA, and FSSC 22000. Including - Personal Hygiene, Supplier Control, Sanitary Design of Equipment and Infrastructure, Procedures for Raw Material Reception, Storage and Finished Product Loading, Sanitation Program. (Sanitation Standard Operating Procedures (SSOPs)., Training programs, Infrastructure, Personal habits, Hygiene verification, Water in the food industry, Water sources, Water uses, Water quality, Treatments, Cleaning, and sanitation, cleaning agents, Sanitizing agents, Equipment and systems, Evaluation of sanitation efficacy- Pest Control, Pest Classification (insects, rodents and birds), Prevention and control. HACCP: History, structure, pre requisites, and principles, HACCP applications, HACCP Based SOPs. Risk Analysis: Introduction to risk analysis, Risk Management, assessment, and communication.		**3,4**
Unit 4	**1504.4**	**Clinicals Trials of Nutraceuticals and health food**	**15**	

		Basic Toxicology, Acute Toxicity studies with reference to Nutraceuticals: Multiple exposure studies Basic Pharmacology & pharmaceutical chemistry History of clinical research regulations in India: Indian Laws, Experimental design of clinical trials, Clinical Trial Life cycle, Phases of clinical trials, Metabolism studies Clinical trials and Regulatory affairs Testing drugs in-vitro and in-vivo, Indian Legal framework for clinical trials for Nutraceuticals& medical research; Regulatory Bodies		**8**

References:

Quality Management in Nutraceuticals, Chi Tang Ho & Quan Yi Zheng (Ed.), American Chem. Soc., 2002

33. Quality Assurance for the Food Industry by J. Andres Vasconcellos CRC press

34. Regulations and Quality: Pharmaceutical Manufacturing Handbook, Shayne Cox God (Ed.), Wiley Interscience 2008.

• Chi-Tang Ho and Qun Yi Zheng, Quality management of nutraceuticals, American chemical society,200.

• Shayne Cox God (Ed.) Regulations and Quality: Pharmaceuticals Manufacturing Handbook, Wiley Inter science 2008.

• Food Safety and Standards Act.2006, Rules and Regulations 2011,8th edition.

• FSSAI, Manuals on Milk and Milk products.

• FSSAI, Manuals on oils and fats

• FSSAI, Manuals on fruits and vegetables

• FSSAI, Manuals on cereals and its products

• FSSAI, Manuals on food additives

• FSSAI, Manuals on mycotoxins

• FSSAI, Manuals on spices and condiments

• FSSAI, Manuals on metals

• FSSAI, Manuals on water analysis

• FSSAI, Manuals on general guidelines on sampling

• FSSAI, Manuals on methods of testing of alcoholic beverages.

• FSSAI, Manuals on beverages, sugar products and confectionary

• FSSAI, Manuals on meat and its products, fish and its products

• Mridula and Sreelata, Food science and processing and technology, Vol 2.

• Timotht. S. Tracey and Richard L. Kingston, Herbal products.

• Prof. P. H. Kulkarni, Ayurveda ahar. (Food/ diet).

• Nutraceutical and Functional Food Regulations in the United States and around the world, Second edition, Debasis Bagchi, Elsevier Press

Examination:

- **Internal Examination (25 Marks):** 20 Marks exam (Written Exam). And 5 Marks for Overall Conduct

- **End Semester theory examination (75 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2hours 30mins
- **Combined passing of 40% with minimum 20% in Internal Component.**

Course: MSc Nutraceuticals Practical
Semester-IV
Course Title: Practical/Paper I
Course Code: GNKPSNTMJ1P504
Credits: 02
No of Practical (Hours): 60
Marks: 50 (30+20)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To enable students, evaluate food establishments for their consumer acceptability and sanitation attributes.
2	To describe the hygiene and sanitation in food processing plant, equipment, storage, and handling
3	To acquaint students with nutraceutical product development, clinical testing and toxicity aspects.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand the basics of microbiological analysis, which include culture media preparation, microorganism separation, preservation of culture media, and spoilage detection.	1,8	1,3,5	U, C
CO 2	Assess the effectiveness of disinfectants and sanitizers.	1,2	5	U, An
CO 3	Evaluate the BOD, COD, and microbiological content of industrial effluents for quality and safety.	1,2,5	1,5	R, E
CO 4	Assess the milk and water's microbiological safety in terms of the presence of coliforms and live organisms.	6,7,8	5,6	U, E
CO 5	Comprehend the effects of adulterants and toxic products in foods.	3,5	4,7	R, An, E

References:

- Handbook of food toxicology by S. S. Deshpande
- Nutritional and safety aspects of food processing by Tannenbaum SR
- Microbiological safety of food by Hobbs BC, 1973,
- Chemical toxicology of food by Galli, C.L, 1978
- Principle method of toxicology by Andrew Wallace Hayes, 2001
- Food toxicology by William Helferich, Karl Winter, 2001
- The food safety information handbook by Cynthia A. Robert, 2009

Course: MSc-II Nutraceuticals
Semester-IV
Course Title: Nutraceuticals
Paper II: Entrepreneurship skills for Nutraceuticals/Food Industry
Course Code: GNKPSNTMJ2504
Credits: 04
No of lectures (Hours): 60
Marks: 100 (60+40)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To expose the student with fundamental knowledge of Entrepreneurship. It will also impart knowledge related to the applications of computation in food industries
2	The students will be able to understand Entrepreneurial spirit and resourcefulness, learn the concept and process of entrepreneurship - its contribution in and role in the growth and development of individual and the nation, strive for entrepreneurial quality, competency, and motivation, learn the process and skills of creation and management of entrepreneurial venture.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Recognize, report, examine and solve multiple technical and organizational problems of food sector applying sustainable solutions to real world problems and also develop technical knowledge to start up a food business	2,3,7	3,4	U, Ap
CO 2	Understand and compare different types of entrepreneurship styles and qualities	1,7	1,7	U, An, E
CO 3	Prepare business plan	2,4	4,6,7	C, Ap
CO 4	Gain knowledge of basic branding and marketing strategies, financial management for food industry ventures.	1,5,7	1,3,6	R, U, Ap
CO 5	Analyse the factors that influence entrepreneurship in the food industry, including market trends, consumer preferences, and regulatory environment	2,3	4,5,8	R, U, An
CO 6	Develop the necessary skills required for entrepreneurship in the food industry, such as creativity, leadership, problem-solving, and decision-making	2,3,6	5,7	U, Ap, E
CO 7	Assess the competencies, scope, and opportunities available for new entrepreneurs in the food industry	3,7,8	2, 8	Ap, An, E

Unit		Title	No. of lectures	CO Mapping
Unit 1	**2504.1**	**Introduction to Entrepreneurship**	**15**	
		(Concept, Functions, Need, Importance, Myths about Entrepreneurship, Pros and Cons of Entrepreneurship, Process of Entrepreneurship) Definition and meaning of entrepreneurship -Types, Classification, and trends of Entrepreneurial ventures in foods and nutrition -Qualities and skills of an entrepreneur -Resources required for a business -Project formulation, Government and non-government opportunities for funds and resources. – Franchising opportunities Institutional support in enterprise development and management. WTO: Functions and Agreements with Reference to TRIPS, TRIMS and GATS.		**1,2**
Unit 2	**2504.2**	**Financial Management**	**15**	
		Understanding the role of finance in Organizations Performance appraisal and assessment; Enterprise selection, market assessment, enterprise feasibility study, SWOT Analysis. Resource mobilisation – finance (sources of Funding) technology, raw material,site, and manpower. Budgeting and Financial Forecasting • Sources of Funding for Entrepreneurial Ventures, Costing and marketing management and quality control. Feedback, monitoring, and evaluation		**1,2,7**
Unit 3	**2504.3**	**Marketing Management I**	**15**	
		Concepts of marketing -Channels of distribution -Market Research and Marketing strategies. Exit strategy. Brief Introduction to Demand Forecasting Market segmentation, targeting and positioning (5P's (Product, Price, Place, Promotion, People) Brand development and promotion. Digital marketing Activity: Creating a marketing plan for a startup venture		**4,7**
Unit 4	**2504.4**	**Marketing Management II**	**15**	
		Human resource management: Personnel action, retention and productivity improvement Understanding the Microenvironment and the Macro Environment, PEST Analysis, Exit strategy, Legal, ethical and environmental consideration of the entrepreneurial venture		**5,6**

References:

- Chhabra TN and Suria RK. 2001. Management Process and Perspectives. Kitab Mahal.
- Jhingan ML. 2005. International Economics. 5th Ed. Virnda Publ.
- Kotler P. 2000. Marketing Management. Prentice Hall.
- Reddy SS, Ram PR, Sastry TVN and Bhavani ID. 2004. Agricultural Economics. Oxford & IBH.
- Blank, S. G., & Dorf, B. (2012). The startup owner's manual: The step-by-step guide for building a great company. Pescadero, California: K&S Ranch.

Examination:

- **Internal Examination (25 Marks):** 20 Marks exam (Written Exam). And 5 Marks for Overall Conduct.
- **End Semester theory examination (75 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2hours 30mins
- **Combined passing of 40% with minimum 20% in Internal Component.**

Course: MSc Nutraceuticals Practical
Semester-IV
Course Title: Practical/Paper II
Course Code: GNKPSNTMJ2P504
Credits: 02
No of Practical (Hours): 60
Marks: 50 (30+20)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To familiarize students with the practical development of a business model.
2	To make students competent in marketing a business idea.
3	To identify scope for entrepreneurship in nutraceutical and utilize the schemes promoted through various governmental and non-governmental agencies.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Applying a strategic plan to construct a new business.	2,4,6	7,8	C, Ap
CO 2	Develop the ability to market, appraise, and advertise the business.	5,7,8	6,7	C, U
CO 3	Develop competencies (leadership, technical and managerial) needed to recognise and explore a nutraceutical-based business opportunity, support.	2,4,7	3,4,6	C, U, Ap1,3,4

	development of self and the team and articulate skill development through reflective practices.			
CO 4	Carry out research; produce and present a business plan to venture capitalists and funding agencies; follow ethical practices in a proposed business idea.	1,3,4	3,4,6	C, Ap, An
CO 5	Develop entrepreneurial skills to execute a start-up in food business.	5,7,8	7,8	C, Ap, E

References:

- Innovation and Entrepreneurship (1985) by Peter F. Drucker
- Barney, J. B., & Hesterly, W. S. (2006). Strategic management and competitive advantage: Concepts and cases. Upper Saddle River, NJ: Pearson/Prentice Hall.\
- Baron, R. A., Shane, S. A., & Reuber, A. R. (2008). Entrepreneurship : a process perspective (1st Canadian ed.). Toronto, ON: Thomson/Nelson.
- Blackburn, R. (2011). Foreword. In L. P. Dana (Ed.), World Encyclopedia of Entrepreneurship. Cheltenham, UK: Edward Elgar Publishing Limited.

Course: MSc-II Nutraceuticals
Semester-IV
Paper III: Intellectual Property Rights & Soft skills (Elective)
Course Code:GNKPSNTEL1504
Course Title:
Credits: 03
No of lectures (Hours): 45
Marks: 75 (45+30)

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	Understanding of laws and legal provisions for food in India
2	Understanding of FSSAI standards and amendments.
3	Understanding of quality parameters for food safety.
4	To give an idea about IPR, registration and its enforcement

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand regulatory based knowledge.	1,7,8	5,6	R, U
CO 2	Analyse and formulate a product based on regulations.	1,2,3	6	U, Ap, An
CO 3	Analyse and apply IPR and its value in economy	7,8	5,6	U, Ap, E
CO 4	Develop skills in conducting IPR searches, including novelty/patentability searches using patent databases.	1,2,3	6	C, U, Ap
CO 5	Apply intellectual property law principles to Nutraceutical research and product generation.	1,3,4	3,5	U, Ap
CO 6	Understand the legal and practical steps needed to ensure that IPR remains valid and enforceable; demonstrate the capacity to identify, apply and assess ownership rights and marketing protection to Nutraceutical-based products.	1,5,7,8	4,5,6	U, Ap, An, E
CO 7	Analyse ethical and professional issues arising in Nutraceutical research and development about IPR.	1,4,5	4,5,6	U, An

Unit		Title	No. of lectures	CO Mapping
Unit 1	**1504.1**	**Introduction to IPR**	**15**	
		Introduction: Concept of IPR - Understanding the meaningof IPR & its significance in knowledge-based economy Types of IPR - Patents, Trademarks & Service Marks, Design Registration, Trade Secrets, Geographical indications, Protection of New Plant Varieties, Copyright. Global Harmonization - Impact of IPR on global trade andthe need for harmonization, WTO, and its role in a global harmonization, AGREEMENTS AND LEGISLATIONS: TRIPS and introduction to the articles in TRIPS document. International Agreements related to IPR & Patents -Paris Convention,PCT, UPOV – Important examples of IPR		**1,2,3**
Unit 2	**1504.2**	**REGISTRATION OF IPRs**	**15**	
		Meaning and practical aspects of registration of Copy Rights,Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registrationin India and Abroad. Patents Introduction, Key definitions, Filing of Patent Application, Publication of application, Provisional and complete specification, Divisional application and patent of addition, Convention application, international application and national phase application, Examination and grant, Post-grant opposition, Post-grant procedures, Appeals, Revocation of patent, Compulsory licensing, Use of patent for purposes of Government, Patent agents, Offences and penalties		**4,6**
Unit 3	**1504.3**	**Soft Skills**	**15**	
		Corporate & Office Etiquette: Transition from College to Corporate world; Perceptions v/s Real Corporate life; Teamwork; Basics of corporate communication; Elements of a good handshake; Visiting cards exchange & How to manage business cards; Small Talk & Networking Personality Development: Understanding Personality, Levels of Human Learning, Creativity and Lateral thinking; Developing Positive Mental Attitude; Emotional Quotient; Handling Criticism; Positive Health Email Writing: Contents of email, Importance of a good subject line; Dos and Don'ts; Using your email software to its maximum; Setting up signatures; Setting up accounts, Importance of acknowledging emails; Creating folder structure for easily accessing emails, Writing typical emails, sending point-wise reply to emails.		**5,6,7**

References:

- Erbisch FH and Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI, Wallingford.
- Ganguli, Prabudha. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill, New Delhi.
- India, Ministry of Agriculture. 2004. State of Indian Farmer. Vol. 5. Technology Generation and IPR Issues. Academic Foundation, New Delhi.
- Intellectual Property Rights: Key to New Wealth Generation.2001. NRDC and Aesthetic Technologies, New Delhi.
- Rothschild, Max & Newman, Scott (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI, Wallingford.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya, Delhi.
- The Indian Acts - Patents Act, 1970 & Amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 & amendments; Layout Design Act, 2000; PPV & FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

Examination:

- **Internal Examination (25 Marks):** 20 Marks exam (Written Exam). And 5 Marks for Overall Conduct
- **End Semester theory examination (75 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2hours 30mins

Combined passing of 40% with minimum 20% in Internal Component

Course: MSc Nutraceuticals Practical
Semester-IV
Course Title: Elective Practical
Course Code: GNKPSNTEL1P504
Credits: 01
No of Practical (Hours): 30
Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To ideate and apply IPR skills for innovations based on Nutraceutical
2	To equip students with information on intellectual property rights (IPR), associated legal frameworks, their importance, and how to use IPR to generate income and value in a knowledge-based economy
3	To analyze ethical and professional issues arising in nutraceutical research and development about IPR.
4	The student will gain the ability to understand Intellectual property rights and their value in economy

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Distinguish the legal and practical measures required to guarantee that intellectual property rights (IPRs) are upheld; exhibit the ability to recognize, utilize, and evaluate ownership rights and marketing. protection for goods based on biotechnology.	1,2,3	3,5	R, Ap, An
CO 2	Apply intellectual property law principles to nutraceutical research and development.	2,5	6,8	Ap
CO 3	Analyse ethical and professional issues arising in nutraceutical research and development about IPR.	4,7,8	6,7,8	An, C
CO 4	Understand Product Development and International Trade for the food sector	2,3,7	1,8	R, Ap

List of Experiments:

1. Patent evaluation and assessment.
2. Patent database search and reporting.
3. Hands-on Exercise of Patent Search /Patent Specification / Claims writing

SEMESTER IV

Lab 1: GNKPSNTMJ1P504

1. Perform molecular modelling (3D protein structure prediction) & perform Structure evaluation & Validation
2. Molecular docking
3. Case study on Comparison of Nutra companies (India vs other countries)
4. Efficacy of sanitizing agent at various dilution
5. Microbial analysis of water and Milk – MPN and MBRT
6. Biochemical test for characterization of bacteria (IMVIC)
7. Demonstration of practical BOD and COD

Lab 2: GNKPSNTMJ2P504

1. The contribution of notable entrepreneurs in the field of Food technology & Nutraceuticals/Functional Food. (Case study)
2. Activities could include researching different funding sources such as bootstrapping, loans, venture capital, angel investors, and crowdfunding. Students could analyze case studies of successful startups that utilized various funding options.
3. Activity: Drafting a business plan for a hypothetical venture
4. Activity: Case study analysis on legal and regulatory challenges
5. Activity: Creating a marketing plan & Financial modeling exercise for a startup venture
6. Activity: Create social media pages for your product
7. Visit a startup venture (optional)

Lab 3: GNKPSNTEL1P504

1. Patent evaluation and assessment.
2. Patent database search and reporting
3. Hands-on Exercise of Patent Search /Patent Specification / Claims writing

RESEARCH PROJECT: Credits: 06 (GNKPSNTRP504): 150M

The project should involve project work/ product development of 8 to 12 weeks period. Project must involve application of knowledge and skills as prescribed in the syllabus and data evaluation must involve application of biostatistics.

Students must submit a project report covering the work undertaken. The project report (including mentors report) and observations / data generated will be presented and defended before the panel of examiners.

DISSERTATION RESEARCH PROJECT

COURSE OBJECTIVES:

Sr. No.	Course Objectives
The course aims at:	
1	To enable students, explore, independently, topics of research importance related to the food industry
2	To empower students to design a research study based on the principles of scientific research
3	To train students in interpreting, analysing, and reporting collated data related to a topic of study
4	To endow students with skills required for scientific writing and publication

COURSE OUTCOMES

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Identify a research query based on the knowledge acquired across the earlier 3 semesters and relevant scientific literature.	3,6	1,4,8	An, R
CO 2	Apply ethical principles of scientific research in collecting relevant data, analyse and represent it appropriately.	3,4,5	1,8	Ap, An
CO 3	Critically evaluate the data obtained and compare it with existing scientific literature for its validity and applicability	2,3,5	1	U, R, An
CO 4	Design the research study, plan and execute the research project and validate the methods for reliability and reproducibility.	6,8	1,8	C, Ap, An
CO 5	Proficiently document the research work based on the principles of scientific writing.	6,7,8	1,5	C, An, E

Project Evaluation:

The project shall be for at least 4 to 5 months, which can be accommodated in the last wholesemester for the project only. Students can even opt for outhouse project work.

Guide mark: 50 Marks

Examiner: 50 Marks

External Examiner: 50 Marks

Internal and external will take presentation exams of students at the end of semester. Theaverage mark shall be recommended from internal and external examiner.

If research paper gets published on the student work in given duration, then you can keep the choice to give +25 marks.

This can increase the publication from department without external funding.