**FOOD ENGINEERING AND TECHNOLOGY DEPARTMENT**

**M. TECH. (FOOD BIOTECHNOLOGY)**

**COURSE SYLLABI**

**Semester I**

**1. Course Number: FDT 2051**

Title of course: Basic Food Science & Technology (Core theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: None

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| **No.** | **Topic** | **No. of lectures** **(1h each)** | **No. of tutorials (1h each)** |
| 1 | Basics of food chemistry, microbiology, biochemistry; chemical composition, chemistry of food ingredients and components affecting the properties of foods such as texture, colour, taste, odour, functional properties etc. Relation of food with nutrition. | **10** | **05** |
| 2 | Standards of identity, purity and methodology for analysis of cereals, legumes, oil seeds, tubers, fruits, vegetables and their products, tea, coffee, cocoa, chocolate, spices, condiments; the effect of food constituents on quality of foods; different forms of water present in foods and their effect on quality and preservation of foods; chemical and enzymatic changes affecting the above properties during harvesting, preparation, storage, processing etc. | **10** | **05** |
| 3 | Introduction to food processing of various foods including dairy, bakery, agri commodities and newer developments such as fabricated foods, functional foods, designer food, nutraceuticals, probiotics and prebiotics. Concept of personalized nutrition and special food for infants, women etc. | **10** | **05** |
|  | **Total contact hours** | **30** | **15** |

**Books Recommended:**

1. Food Science- Norman Potter, Springer; 5th ed. 1995 edition (31 July 1999)

2. Biochemistry of Foods - N.A. Michael Eskin, 1990, Academic Press, California

3. Food Chemistry - O. R. Fennema, 4th ed. 2007, CRC press.

4. Kulp K. and Ponte J.G. Jr. (2000). *Handbook of Cereal Science and Technology.*New York/Basel: Marcel Dekker Inc.

5. Essentials of Food and Nutrition by Swaminathan Vol. I and II

**2. Course Number: FDT 2052**

Title of course: Fundamentals of Food Biotechnology and Genetics (Core theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic knowledge of biochemistry and microbiology

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| **No.** | **Topic** | **No. of lectures (1h each)** | **No. of tutorials (1h each)** |
| 1 | Fermentative production of enzymes used in food industry; solid state fermentation; recovery of enzymes from natural sources; cheese making and whey processing, impact of enzyme technology (bioethanol, protein hydrolysates, bioactive peptides); enzymatic processing of fruit juices. Role of enzymes in baking, meat and meat processing; comparative methods of toxicity testing in (novel) foods; biosensors; enzymatic approach to tailor made fats; catabolic processes and oxygen-dependent reactions in food; use of lipases and reactions in organic solvents and two phases. | **10** | **05** |
| 2 | Chemical structure of nucleic acids, proteins; introduction to Genetics, DNA replication, transcription and translation; cell division, cell cycle, mitosis, meiosis; introduction to human genetics; Mendelian genetics; single cell disorders; complex traits; DNA repair mechanism; modifying enzymes; recombinant DNA technology; mutation and polymorphism and their detection; family based and case control study designs; pedigree analysis; linkage analysis and association studies. | **10**  | **05** |
| 3 | PCR, RT-PCR, electrophoresis, electro blotting and capillary blotting; population & evolutionary genetics, gene mapping; microbial gene transfer mechanisms, mutation, types of mutations, molecular mechanism of mutations, practical applications; application to produce genetically modified foods | **10** | **05** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended:

1. Fundamentals of food biotechnology by Byong H.Lee

2. Food biotechnology by Kalidas shetty

3. Food Biotech, 1989, Angold

4. Fundamentals of food biotech, 1996, Lee B.H

**3. Course Number: FDT 2075**

Title of course: Basics of Human Nutrition (Elective theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic understanding of biochemistry and food chemistry.

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| **No.**  | **Topic** | **No. of lectures (1h each)** | **No. of tutorials (1h each)** |
| 1 | Introduction to nutrition, Energy value of foods, physiological fuel value, estimation of energy value of foods from proximate composition, calorie needs for Basal metabolism, physical activity and DIT | **04** | **02** |
| 2 | Requirements and role of carbohydrates, proteins, lipids, water, vitamins and minerals in human health and RDAs and estimation of protein quality- in vitro and in vivo methods | **10** | **05** |
| 3 | Antinutritional factors in plant foods, effect of processing, preservation and storage on nutritional quality of foods, nutrient interactions, food nutrification, nutritional labeling  | **04** | **02** |
| 4 | Diet vs Disease, therapeutic diets, dietetic foods, health foods, formulation of diets and foods for special needs, Sports nutrition | **05** | **2.5** |
| 5 | Techniques of diet and health surveys, assessment of nutritional status, lifecycle nutrition, infant nutrition and infant foods, geriatric nutrition and geriatric foods, maternal nutrition | **05** | **2.5** |
| 6 | Nutraceuticals and functional foods and introduction to nutrigenomics | **02** | **01** |
|  | **Total contact hours** | **30** | **15** |

Books recommended:

1. Modern Nutrition in Health and Disease by Young and Shils
2. Food, Nutrition and Diet Therapy by Krause and Mahan

**4. Course Number: FDT 2002**

Title of course: Food Safety & Toxicology (Elective theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic understanding of microbiology, food additives, chemistry of food constituents.

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| **No.** | **Topic** | **No. of lectures (1h each)** | **No. of tutorials (1h each)** |
| 1. | Types of food hazards: biological, chemical and physical; Risk assessment; Existing and emerging pathogens due to globalisation of food trade; Newer systems of safety evaluation such as HACCP. | **10** | **05** |
| 2. | Testing of food ingredients & additives; Animal studies including LD50; Ames test for teratogenicity; Natural toxic constituents in plant foods; Shellfish poisoning; Chemicals from processing such as fumigants, chlorinated solvents, autoxidation products, carcinogens in smoked foods and pyrolysis, pesticides and herbicides | **10** | **05** |
| 3. | Intentional and unintentional additives; Toxicity due to microbial toxins including botulin and staphylococcal toxins, mycotoxin and due to other food pathogens; Food allergy and intolerance; Detoxification strategy. | **10** | **05** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended:

1. Handbook of food toxicology by S. S. Deshpande

2. Nutritional and safety aspects of food processing- Tannenbaum S. R.

3. Microbiological safety of foods- 1973, Hobbs, B. C.

**5. Course Number: FDP 2051**

Title of course: Food Technology Laboratory (Practical course)

 (50 marks, 3 credits, 6h per week)

Prerequisites: Basic understanding of principles of food processing and preservation as well as understanding of basic principles of food analysis.

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| **No.** | **Topic** | **No. of practicals****(4h each)** |
|  | **Food Processing Practicals** | 01 |
| 1. | Fruit processing | 01 |
| 2. | Fruit processing | 01 |
| 3. | Fruit processing | 01 |
| 4. | Tomato processing | 01 |
| 5. | Milk processing | 01 |
| 6. | Dehydration  | 01 |
| 7. | Baking  | 01 |
| 8. | Traditional food | 01 |
| 9. | Premix formulation | 01 |
| 10. | Demo of spray drier, extruder, SCFE, Tray drier | 01 |
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|  | **Food Analysis Practicals** |  |
| 11. | Analysis of milk (liquid) | 01 |
| 12. | Detection of adulterants in milk (liquid) | 01 |
| 13. | Analysis of wheat flour | 01 |
| 14. | Determination of damaged starch from whole wheat flour | 01 |
| 15. | Analysis of tea | 01 |
| 16. | Analysis of coffee | 01 |
| 17. | Estimation of chlorophyll and carotenoids | 01 |
| 18. | Food adulteration | 01 |
| 19. | Sensory analysis of Foods | 01 |
| 20. | Demo of Hunterlab colorimeter, texturimeter, kjeltech, soxtech, fibretech, DSC | 01 |

**6. Course Number: FDP 2061**

Title of course: Project I: Critical review of one research publication (P) (Presentation + report submission)

 (50 marks, 3 credits, 6h per week)

Prerequisites: Preliminary understanding of food science and technology, food analysis, food biotechnology and research methodology.

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| Subject  | **Critical Review of one Research Paper** |
| Instructions to candidates | In this project, the candidate is expected to review a single research publication as decided by faculty/research advisor. Based on this the candidate is expected to give a presentation to evaluation committee comprising of the research guide and one Faculty member from the Department/ Institute. In general a written report (on similar guidelines as given for project II) also needs to be submitted.Some general guidelines for the critical analysis of a research publication include:**Originality**1. Are the facts and ideas new or have they been covered before by this author or other authors?
2. Is there enough useful information to warrant this paper; and whether the length of the paper is justified?
3. If you feel the material is not new please cite references in which it has already been reported

**Technically correct**1. Is the paper technically correct?
2. Are assumptions reasonable?
3. Is the reasoning logical?
4. If you think it is not, specify what you think is incorrect and suggest the correct approach
5. Are the methods used in the work appropriate?
6. Are there any internal contradictions or computational errors and are there any loopholes in the observations? If so please explain

**Clarity**Is the paper reasonably easy to follow and understand, complete but not verbose and does it stick to the subject? If not, please comment.**Bibliography**Does the author cite all the references in the text and vice versa?Are the references complete and as per guidelines? Does the manuscript accurately represent statements in cited references and do not reproduce?**Title and Abstract** Is the title suitable and adequate?Does the Abstract (normally 50-150 words) bring out the main points of the paper**Illustrations and Tables**Is there material that could be better recovered in a Table?Is there needless duplication between text illustrations and tables?Are there too many illustrations or Tables?Are the illustrations clear and legible?Are the experiments/ results and Discussion/illustrations/tables same/ similar to other papers in similar area?Are there other valid interpretations of the observations? If so, please elaborate |

**7. Course Number: FDP 2062**

Title of course: Project II: Seminar (P)

 (50 marks, 3 credits, 6h per week)

Prerequisites: Preliminary understanding of food science and technology, food analysis, food biotechnology and research methodology.

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| Subject  | **Seminar**  |
| Instructions to candidates | 1. The seminar work is concerned with a detailed and critical review of an area of interest to Food Biotechnology. Typically, the report should contain and will be evaluated based on the following points:**Introduction:** 2 pages maximum**Exhaustive review of literature (including figures):** 10 – 12 pages **Critical analysis of the literature and comments on the analysis:** Critical analysis should also contain quantitative comparison of observations, results, and conclusion amongst the various papers.2. Two typed copies of the report on thesis size bond paper (297 mm x 210 mm) are to be submitted to Coordinator. 3. The report should be prepared using the Times Roman font (size 12) using 1 1/2 spacing leaving 1-inch margin on all sides producing approximately 29 lines per page. The report should be typed on one side of the paper and need not be bound in a hard cover binding. Figures and tables should be shown as a part of the running text. Each figure should be drawn inside a rectangular box of 12 cm width and 10 cm height. The figures must be sufficiently clear and hand drawn figures will be acceptable. Particular care must be taken if a figure is photocopied from source. Each figure must have a sequence number and caption below. Each table must have a sequence number and title at the top.4. Name of the student, title of the seminar and year of examination must be indicated on the top cover. The name of the supervisor (only initials) must appear on the bottom right corner of the top cover.5. The report must be precise. All important aspects of the topic should be considered and reported. The total number of pages, including tables, figures, and references should not exceed 30. Chapters or subsections need not be started on new pages, while getting the report typed.6. Typographical errors in the report must be corrected by the student. The student will be discredited for any omission in the report. All the symbols used in the text should be arranged in an alphabetical order and given separately after conclusions.7. The list of references should be arranged in alphabetical order of the names of authors. In the text, the reference should be cited with author's name and year. (author - date style) For example:(i) Procedures used to experimentally evaluate the thermal resistance kinetics of microorganisms are summarized in literature (Stumbo et al., 1973).OR(ii) Stumbo et al. (1973) has summarized procedures used to experimentally evaluate the thermal resistance kinetics of microorganisms.The title of the article should also be included in the list of references. The references must be given in the following standard format.(a) Format for listing references of articles from periodicals: Gokhale, S. V., Jyoti, K. K., Lele, S. S., “Modeling of Chromium (VI) Biosorption by Immobilized Spirulina platensis in Packed Bed Column”, J Haz Mat, 170, 735-743 (2009).(b) Format for listing references of Books:Paul Singh, R., Heldman, D.R., “Introduction to Food Engineering” (3rd ed). Academic Press, New Delhi, pp. 104-110, 2004.(c) Format for listing Thesis: Gokhale S, “Process Development and Modelling of Preservation Techniques for Indian Traditional Foods”, Ph.D. (Tech.) Thesis, University of Mumbai, 2010(d) Format for listing references of Patents in Chemical Abstracts:Cananaush R.M., U.S.Patent 2,647,141, Cf. C.A. 48, 82636 (1954).(e) Format for listing Handbooks, Tables, Symposia etc.:Okos, M.R., Narsimhan, G., Singh, R.K., Weitnauer, A.C., “Food Dehydration”, in Handbook of Food Engineering, Heldman, D.R. and Lund, D.B. (Eds.),. Marcel Dekker, New York, pp. 437-562, 1992.(f) Format for listing Private Communications and other categories:Sharma, M.M., Private Communication (1984).8. Consistency of units should be maintained in the written report. SI system should be used. [For SI system - Ref: Ind. Chem. Engr., 24, 32, 3 (1983)]. Units used in the literature (if not SI) should be correctly converted.9. The time allotted for the oral presentation of seminar is 20 minutes: additional 10 minutes are provided for questions and answers.10. INCOMPLETE AND CARELESSLY WRITTEN REPORT IS LIABLE TO BE REJECTED.11. The last date for submission will NOT be extended on any grounds whatsoever.12. There must not be any acknowledgment about the guidance by the faculty in the Seminar.13. The Seminar will be evaluated on the basis of (i) rational approach to the problem, ii) correctness and completeness of the written text and iii) performance in the oral presentation.Note: Word-to-word copying from the published article is not permitted. Flowery language is not to be used.  |

**Semester II**

**1. Course Number: FDT 2053**

Title of course: Fundamentals of Food Process Engineering (Core theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic knowledge of common unit operations and heat and mass transfer.

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| **No.** | **Topic** | **No. of lectures (1h each)** | **No. of tutorials (1h each)** |
| 1. | Transport phenomenon; heat transfer, mass transfer in food processing; problems of equipment design with reference to common food processing unit operations such as drying, freezing, evaporation, membrane filtration. | **10** | **5** |
| 2. | Principles of thermal processing; calculation of process time- temperature schedules. Other important principles of preservation of foods. | **8** | **4** |
| 3. | Processing of fruits, vegetables, grains; effect of genetic modifications in crops and linkage with processing; non-thermal methods; high pressure processing; transgenic animals and subsequent implications on dairy, meat and fish products; legal and safety issues. Flow sheets and preliminary cost analysis | **12** | **6** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended

1. Fundamentals of food biotech by Lee B.H, 1996

2. Experiments in food process engineering, 2004, Pandey

**2. Course Number: FDT 2055**

Title of course: Biotechnology of fermented foods (Core theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic understanding of microbiology, microbial metabolism, enzymes, chemical composition of substrates used.

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| **No.** | **Topic** | **No. of lectures** **(1h each)** | **No. of tutorials** **(1h each)** |
| 1. | Functional foods, Traditional applications of food biotechnology- Fermented foods: eg dairy products, oriental fermentations, alcoholic beverages, and food ingredients; the role of biotechnology in fermented food products (dairy, meat, vegetable); Starter culture development, process development; Enzymes in the dairy industry: cheese making and whey processing, impact of enzyme technology; |  **15** | **7.5** |
| 2. | Enzymatic processing of fruit juices; Role of enzymes in baking, meat and meat processing. Applications of immunological techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. Botulinum & Salmonella from food samples. Newer Processing Technology, Pesticide Residues, Newer Sources of Ingredients, Nutraceuticals, Use of Antibiotics & Hormones in Food Processing & Agricultural Practices etc. | **15** | **7.5** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended

1. Industrialization of indigenous fermented foods by Keith H. Steinkraus

2. Microbiology of fermented foods by Brian J.B.Wood

3. Advances in Biochemical engineering, Vol 3, 1974, Ghose T.K.

**3. Course Number: FDT 2054**

Title of course: Cell Culture Technology (Core theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic understanding of plant and animal biology.

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| **No.** | **Topic** | **No. of lectures** **(1h each)** | **No. of tutorials** **(1h each)** |
| 1. | Introduction to plant and animal tissue cultures and cell cultures in general. | **4** | **02** |
| 2. | Plant tissue culture: Concept of totipotency, differentiation and redifferentiation; callus growth patterns/ characteristics, organogenesis, hairy root culture; somaclonal variations, somatic embryogenesis, synthetic seeds, anther and pollen culture, embryo culture and significance of haploid plants; | **8** | **04** |
| 3. | Plant tissue culture techniques for crop improvement; protoplast technology: isolation & fusion, somatic hybridization and hybrids; production of virus free plants; production of secondary metabolites, indexing for plant pathogens. | **6** | **03** |
| 4 | Animal, mammalian and other cell lines and therapeutic and other biomolecule production | **6** | **03** |
| 5 | Technological aspects for commercial utilization of cell cultures | **6** | **03** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended

1. Culture of animal cells by R. Ian Freshney

2. Animal cell culture and technology by Butler, 2004

3. Introduction to plant tissue culture, 1998, Razdan

**4. Course Number: FDT 2021**

Title of course: Enzymes in the Food Industry (Elective theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic understanding of enzymology, microbiology and food processing.

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| **No.** | **Topic** | **No. of lectures (1h each)** | **No. of tutorials (1h each)** |
| 1. | Introduction to enzymes used in Food industry, Objectives of using enzymes in food processing and in food product development, Merits and demerits of using enzymes, Sources of enzymes, Microbial enzymes and their advantages/ disadvantages, Commercially important enzymes used in Food industry and their mode of action, Overview of applications of enzymes in the Food industry, Newer enzymes and their actual and potential applications, Fermentative production of enzymes used in food industry by SSF or SmF, Recovery and purification of enzymes | **10**  | **05** |
| 2.  | Use of enzymes in: Dairy, Bakery, Brewery, Fruit and Vegetable Processing, Plantation Products, Starch industry and confectionery, Protein hydrolysis for protein hydrolysate and bioactive peptides, Oilseeds processing, formation of TAGs, extraction of fish oil, Meat, seafood (like surimi product), poultry, eggs, Animal feed, For treatment of wastes from food industry, For flavor biotransformations | **10**  | **05** |
| 3. | Enzymes in biosensors, Enzymes as additives e.g. antioxidant or antimicrobial, Novel food applications of enzymes, Enzymes in active packaging and in edible coatings and films, Safety of enzymes used in foods, foodgrade enzymes, Immobilization of enzymes for food applications, Recombinant enzymes from GMO | **10** | **05** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended:

1. Novel Enzyme Technology for Food applications

Edited by: Robert Rastall, 1st ed., 2007.

CRC Press, U.S., Woodhead Publication Limited, U. K.

1. Food Processing: Biotechnological Applications

By: Marwaha, 2002.

Asiatic Publishers, New Delhi

1. Biotransformation of Flavours

By: I. L. Gatfield

**5. Course Number: FDT 2006**

Title of course: Food Packaging (Elective theory course)

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic awareness and understanding of different types of food products and commodities requiring packaging.

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| **No.** | **Topic** | **No. of lectures** **(1h each)** | **No. of tutorials (1h each)** |
| 1. | Packaging as a method for conservation of foods; Packaging materials and their physico-chemical characteristics. | **10** | **05** |
| 2. | Evaluation of quality of packaging materials; Package design; Test procedures for packages; Cushioning materials; Selection of packaging materials and package design for food products; Prepackaging. | **10** | **05** |
| 3. | Packaging materials for newer techniques like radiation processing, microwave and radiowave processing, high pressure processing, modified atmosphere and thermal processing as retortable pouches; Biodegradable packaging. | **10**  | **05** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended

1. Developments in Food Packaging V1, 1980, Palling S.J.

2. Modern Food Packaging, 1998, Indian Institute of Packaging

3. A Handbook of Food Packaging, 1992 2nd ed., Paine and Paine

**6. Course Number: FDP 2052**

Title of course: Food Biotechnology Laboratory (Practical course)

 (50 marks, 3 credits, 6h per week)

Prerequisites: Awareness of hazards associated with handling of various chemicals/ reagents, knowledge of principles of analytical techniques used in biotechnology.

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| **No.** | **Topic** | **No. of practicals** **(6 h each)** |
| 1. | Discontinuous native PAGE  | 1 |
| 2. | SDS PAGE  | 1 |
| 3. |  Ammonium sulphate precipitation of enzyme   | 1 |
| 4. | Purification of enzyme by three phase partitioning | 1 |
| 5. | TLC separation  | 1 |
| 6. | Demo of Gel Filtration Chromatography/ IEC  | 1 |
| 7. | Isolation of genomic DNA  | 1 |
| 8. | DNA amplification by PCR  | 1 |
| 9. | Restriction digestion  | 1 |
| 10. | Agarose gel electrophoresis  | 1 |
| 11. | Immunodiffusion  | 1 |
| 12. | Estimation of free radical scavenging activity by ABTS assay  | 1 |
| 13. | Enzyme assay using ELISA reader | 1 |
| 14. | Real Time PCR | 1 |
| 15. | Fruit processing using enzymes | 1 |

**7. Course Number: FDP 2063**

Title of course: Project III: Critical Review of Research Project (P)

 (50 marks, 3 credits, 6h per week)

Prerequisites: Preliminary understanding of food science and technology, food analysis, food biotechnology and research methodology and understanding of how to survey available literature.

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| Subject  | **Critical review of research project** |
| Guidelines  | 1. The presentation should be covered in 20 minutes in the presence of research guide and external examiner.2. The students have to submit a written report after the presentation so that they can incorporate changes/ corrections/ additions/ deletions etc in the report based on the feedback received during presentation. 3. Both the presentation and the report should include the following:* Title of research project
* Introduction (1 to 2 pg)
* Literature Review (10 to 12 pg)
* Research Hypothesis ( 1 to 2 pg)
* Research Objectives (1/2 pg)
* Materials and methods (2 to 3 pg)
* Expected outcome (1/2 pg)
* References (only in report)

4. So overall the report (spiral bound) can be 15 to 20 pages in length + references.5. All the reports should be written in same format and checked for correctness before submission. 6. Presentation can include between 20 to 25 slides for 20 minutes. 7. The slides prepared should be readable and free from errors. |

**Semester III and IV**

Course Number: NA

Title of course: Final year research work for thesis

 (700 marks, 42 credits, 1 year research work)

Prerequisites: Successful completion of semester I and II coursework.

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| Subject  | **Final year research work for thesis** |
| Guidelines for writing thesis | 1. General Instructions1. Use A4-size paper.
2. Leave 1″ top and bottom margin, 1.25″ left margin, 1.25″ right margin on each page.
3. The letter font should Times New Roman with the font size of 12.
4. Line spacing should be 1.5 (one and a half).
5. Initial submission should be soft-bound (spiral binding, etc.). Initially 3 copies should be submitted to the Thesis Section. These copies are to be printed on both sides of the A-4 size paper.
6. After successful completion of the viva voce, final submission should be done. This will include 2 (two) hard-bound copies and a cd-rom. The final copy will incorporate all the suggestions and modifications (if any) required by the internal and external examiners. These copies are also to be printed on both sides of the A-4 size paper.
7. The following table gives the serial order in which the initial Thesis pages should be arranged. Please refer to the respective word files for exact formats.
8. Title page
9. Approval of supervisor(s) and external examiner
10. Certificate by the supervisor(s)
11. Dedication
12. Acknowledgements (maximum 2 pages, single line spacing is acceptable)
13. Declaration by the student
14. List of publications based on the present work
15. List of figures
16. List of tables
17. List of symbols
18. List of abbreviations
19. Abstract and keywords (maximum 1 page)
20. Contents
21. The Body of the Thesis
* The body of the Thesis contains the work done by the student. It should tentatively have the following sections: Introduction, Objectives and Scope, Literature survey, Work done on each objective, Results and Discussion, Conclusions, Recommendations for Further Work, and References.
* Attach appendices, if required, and include those in the table of contents. Sections will be numbered 1, 2, 3, etc., while subsections will be numbered 1.1, 1.2, 2.1, 2.2, and 1.1.1, 1.2.1, 2.1.1, 2.2.1, etc.
* TablesTables should be used when necessary.

Tables should be numbered as Table 1.1 (in chapter 1), Table 2.1 (in chapter 2), etc. Table headings should be ideally of one-line length, should appear above the Tables, and should be centred. A variable defined in a column of the Table should have its unit of measurement defined alongside it. The text must have a reference to the Tables and should have an explanation of their contents. Moreover, each table should appear after it is referenced in the text. * FiguresThe figures should be drawn by the candidate; scanned copies just pasted are not acceptable. Exceptions can be made for very complicated diagrams or photographs.

Only important figures should be given. The independent variable is plotted in the horizontal axis of a figure, whereas the dependent variables are plotted in the vertical axis of the figure. The units of measurement must appear alongside the names of the variables. In case of multiple curves appearing in a figure, legends should be used to indicate the name of each variable and separate scale should be given for the variables.In the text body, figures should be numbered as Fig. 1.1 (in chapter 1), Fig. 2.1 (in chapter 2), etc. Figure captions should be ideally of one-line length, should appear below the Figures, and should be centered.Figures must be referenced in the text along with discussions on the nature of variation of the dependent variables. In addition, each figure should appear after it is referenced in the text.* Page Numbering

Pages should be numbered beginning with the thesis Title page. Numbers should be printed at the central location of the bottom of each page. Pages should be numbered continuously irrespective of the content being textual, tables, pictures, figures, images, etc. The page numbers should continue from one chapter to another and should not begin with ‘1’ for every new chapter.* References Only the important references (including the student’s own research papers / patents / book chapters, etc.) should be cited and listed in the references.It is mandatory that the student should standardize her / his reference citation style.Most important: Each chapter should not have references. References should be given only at the end of the thesis, after “Recommendations for Further Work’. References should be written in alpha-numeric style, that means, numbering of the references should not be done.
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**Elective courses offered under the M. Tech. in Food Biotechnology program**

**1. Title of course: Nutrigenomics (Elective theory course)**

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Preliminary understanding of human nutrition and genetics.

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| No. | Topic | No. of lectures (1h each) | No. of tutorials (1h each) |
| 1. | Gene- environment interaction; gene- diet interaction; principals and practice behind dietary management of genetically transmitted disorders; phenylketonuria, galactosemia; G6PD deficiency; lactose intolerance; complex traits; birth disorders; signal transduction; epigenetic mechanism; bioactive components of food; nutraceutical; effective gene expression; epigenetic process; signal transduction. | **30** | **15** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended

1. Nutritional Genomics by Jim Kaput, 1st ed., 2006.

2. Nutritional Genomics by Regina Brigelius-Flohé, 2006.

3. Nutrigenetics and nutrigenomics by Artemis P.Simopoulos, 1st ed., 2004.

4. Encyclopedia of genetics, genomics, proteomics by Jorde Lynn, 2005.

**2. Title of course: Marine Biotechnology (Elective theory course)**

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Basic understanding of marine life forms.

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| No. | Topic | No. of lectures (1h each) | No. of tutorials (1h each) |
| 1. | Overview and relevance of Marine Biotechnology in the area of Biotechnology. Phylogeny and taxonomy of species in marine habitats such as microorganisms, protozoans, micrometazoans, microalgae, fungi, fish and crustaceans. Methods of isolation and identification of marine microbes; culture techniques; identification of species; potentially important species from a commercial view point. | **10** | **05** |
| 2. | Structure and chemistry of bio-molecules; carbohydrates, proteins and lipids of fish and shellfish; amino acids, nucleic acids and porphyrins of marine species. | **10** | **05** |
| 3. | Bioactive compounds and commercial bio-products from marine organisms; marine biotechnology for economic development and environmental benefits; bio remediation with marine organisms; marine bio-sensors; transgenic marine organisms. | **10**  | **05** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended

1. Molecular and Cell Biology. Eds.: H.Lodish, A.Berk, S.L. Zipursky, P.Matsudaria, D.Baltimore and J.Damell. Publ.: W.H. Freeman & Company, New York (2007).

2. Marine Ecology. O. Kinee (ed) Volumes I, II & V. Publ.: John Wiley and Sons (1971).

3. Fundamental Principles of Bacteriology, Salle A.J. , Publ.: Tata McGraw Hill (1984).

4. Molecular Biology. R.F. Weaver, Publ.: McGraw Hill (2011).

**3. Title of course: Bioinformatics and Biostatistics (Elective theory course)**

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Fundamental knowledge of biomolecules, fundamental understanding of statistics, and basic computer proficiency.

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| No. | Topic | No. of lectures (1h each) | No. of tutorials (1h each) | Course outcomes | POs correlated | Explanation for intensity |
| 1. | Bioinformatics tools; searching public database e.g. NCBI, protein databases etc. literature search database; primer designing software; restriction mapping software; LpG: proteomics | **10** | **05** | **CO 1:** Since the intake of students is from different streams, the students from Food technology stream will be able to understand the basic tools of bioinformatics and be able to utilise public databases like NCBI and protein databases etc. | **PO1****PO12****PO13** |  |
| 2. | Application of Statistics, bioinformatics and experimental design to biotech processes: Sampling procedures, populations; types of data, data organization and presentation. Correlation and Regression, linear and quadratic regression Analysis of variance. Correlation coefficient; regression analysis; multivariate analysis; principal component analysis. | **10** | **05** | **CO 2:** Students will be able to understand the basics of biostatistics which can be applied to design their experiments and interpret the data in a more meaningful way.  | **PO1****PO12****PO13** |  |
| 3. | Probability. Probability distribution. Testing of hypothesis. Bioinformatics tools for data processing and presentation. Experimental design and factorial design. Concepts and use of software. RSM and ANN techniques for optimization of fermentative processes. | **10**  | **05** | **CO 3:** Students will be able develop an understanding about probability and other bioinformatics tools and be able to understand how to utilise these tools to simulate best possible combinations during experimentation.  | **PO1****PO12****PO13** |  |
|  | **Total contact hours** | **30** | **15** |  |  |  |

Books Recommended

1. Bioinformatics: Application in biological sciences by Rashidi, Hooman.

2. Emerging trends in bioinformatics, Khan Irfan, 2002

3. Bioinformatics, Concepts, Skills and Application-2003, Rastogi

**4. Title of course: Food Standards and Safety Regulations (Elective theory course)**

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: general understanding of food quality and safety as well as food product composition,, food additives, food ingredients

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| No. | Topic | No. of lectures (1h each) | No. of tutorials (1h each) | Course outcomes | POs correlated | Explanation for intensity |
| 1. | Various regulatory standards in India and other countries | **15** | **7.5** | **CO 1:** Students will be able to attain knowledge about the regulatory standards for different foods in India.  | **PO1****PO12****PO13** |  |
| 2. | Codex, US FDA, FSSAI Rules, Labeling, GRAS | **15** | **7.5** | **CO 2:** Students will be able to understand the rules and standards of different regulatory bodies in India and around the world. **CO 3:**  | **PO1****PO12****PO13** |  |
|  | **Total contact hours** | **30** | **15** |  |  |  |

Books Recommended

1. Environmental regulation and food safety, 2006, Veena Jha.

2. Microbiological safety of food, 1973, Hobbs

3. Emerging technologies; food process, 2005, Da-wen

**5. Title of course: Food Product Development and Analysis (Elective theory course)**

 (50 marks, 3 credits, 2L + 1T per week)

Prerequisites: Sound knowledge of food composition and basic understanding of consumer needs, knowledge of nutrition and awareness of various food products and formulations.

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| No. | Topic | No. of lectures (1h each) | No. of tutorials (1h each) |
| 1. | Introduction to food product development, need, importance and objectives of product development in food industry; factors affecting food product development-extrinsic and intrinsic; steps in food product development; methodology involved in food product development; food laws in food product development; process control parameters and scale up of developed products, market testing and marketing plans for developed products, costing and economic evaluation of developed products. | **10** | **05** |
| 2. | Food product development in academic research, food product development in small scale sector, several case studies on food product development in different sectors of large scale food industry such as chocolate confectionary, cereal based products, food flavours, fruit and vegetable products, fishery products etc. | **10** | **05** |
| 3. | New food product development such as functional foods, role of enzymes in food product development, new ingredients for food product development.Role of food analysis in various stages of food product development, overview of various methods of food product analysis including sensory evaluation, developing food product specifications, quality assessment of developed products. | **10** | **05** |
|  | **Total contact hours** | **30** | **15** |

Books Recommended:

1. Accelerating New Food Product Design and Development- Backley, 2007, Blackwell publishing, Oxford, UK.
2. Sensory and Consumer Research in Food Product Design and development- Moskowitz, 2006, Blackwell publishing, Oxford, UK.