SYLLABUS

Bachelor of Food Technology

4th Year (7th & 8th Semester)

(Effective for the Session: 2015-2016 only)
## Study and Evaluation Scheme

**B.Tech (Food Technology) Fourth Year**  
*Effective for the Session 2015-16*

### B.Tech (Food Technology)  
**Year 4th Semester-VII**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Subjects</th>
<th>Periods</th>
<th>Evaluation Scheme</th>
<th>Subject Total</th>
<th>Credit</th>
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**Note:** ** Practical Training (4-6 weeks) done after 6th Semester would be evaluated in 7th Semester through Report and Viva voce etc.

### Open Elective-I

1. EOE-071- Entrepreneurship Development  
2. EOE-072 – Quality Management  
3. EOE-073- Operations Research  
4. EOE-074- Introduction to Biotechnology
<table>
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</table>

Open Elective-II
EOE-081-Non Conventional Energy Resources
EOE-082-Non Linear Dynamic Systems
EOE-083-Product Development
EOE-084-Automation & Robotics

Departmental Elective-I
EFT-011-Food Processing Waste Management
EFT-012-Rheological & Sensory Assessment
EFT-013-Food Physics

Departmental Elective-II
EFT-021-Food Products & Process Development
EFT-022-Specialty Foods
EFT-023-Engineered, Texturized & Fabricated Foods
EOE-071: ENTREPRENEURSHIP DEVELOPMENT

UNIT –I
Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. 5 Government policy for small scale industry; stages in starting a small scale industry.

UNIT –II
Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT –III
Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT –IV
Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

UNIT –V
Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. 5 Role of various national and state agencies which render assistance to small scale industries.

Text / Reference Books:
2. Havinal, Veerbhadrappa, ”Management and Entrepreneurship” New Age International

EOE-072: QUALITY MANAGEMENT

UNIT-I
Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. 3 Control on Purchased Product Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. 2 Manufacturing Quality Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

UNIT-II
Quality Management Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. 3 Human Factor
in quality (11) Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

UNIT-III
Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. 5 Attributes of Control Chart Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.

UNIT-IV
Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT-V

Text / Reference Books:

EOE-073: OPERATIONS RESEARCH

UNIT-I
Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.

UNIT-II
Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.

UNIT-III
Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT.

UNIT-IV
Theory of Games: Rectangular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models.

UNIT-V
Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.
EOE-074: INTRODUCTION TO BIOTECHNOLOGY

UNIT-I

UNIT-II

UNIT-III
Gene Expression: Central dogma, genetic code, molecular mechanism on mutations, regulations of gene expression, housekeeping genes, differentiation and development mutations and their molecular basic. Genetic Engineering: Introduction, cloning (vectors and enzymes), DNA and genomic libraries, Transgenics, DNA fingerprinting, genomics.

UNIT-IV
Applications of Biotechnology: Bioprocess and fermentation technology, cell culture, Enzyme technology, biological fuel generation, sewage treatment, environmental biotechnology, biotechnology and medicine, biotechnology in agriculture, food and beverage technology, production of biological invention.

UNIT-V
Safety and Ethics: Safety, social, moral and ethic considerations, environmental ethics, bioethics and stem cell research, safety of new biotechnology foods, agro biodiversity and donor policies.

Text Books/ Reference Books:
2. P.K. Gupta, “Elements of Biotechnology” Rastogi
3. H. D. Kumar, ”Modern concepts of Biotechnology” Vikas publishing House.

EFT- 701 : FOOD PACKAGING

UNIT-I
UNIT -II
Cellulosic and Polymeric packaging materials and forms: Food grade polymeric packaging materials, Rigid plastic packages. Films: Oriented, Co-extruded, Laminates and Metallised; Cellophane, Olefins, Polyamides, Polyesters, PVC, PVDC, PVA, Inomers, Copolymers, Polycarbonates, Phenoxy, Acrylic and Polyurethane. Their mechanical sealing and barrier properties.

UNIT -III

UNIT -IV

UNIT -V

Book References:

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
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<tbody>
<tr>
<td>M. Mahadeviah and R.V. Gowramma</td>
<td>Food Packaging Materials</td>
</tr>
<tr>
<td>S. Saclarow and R.C. Griffin</td>
<td>Principles of Food Packaging</td>
</tr>
<tr>
<td></td>
<td>Trends in Food Science &amp; Technology Proceedings of IFCON-1988</td>
</tr>
</tbody>
</table>

EFT - 702 FOOD QUALITY AND FOOD LAWS

UNIT -I

UNIT -II
Instrumental measurements of sensory attribute of foods: Appearance, color, volume, density and specific gravity, Rheological and textural characteristics . Texture profile analysis. Correlation between instrumental and Sensory analysis of food quality attributes.

UNIT -III
Nutritional Quality of foods and its assessments: Food proteins (Digestibility, Biological value, NPU, PER), Modifications of foods constituents due to processing and storage and their nutritional implications.

UNIT -IV
UNIT -V

Book References:

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
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<tr>
<td>J.M.DeMan</td>
<td>Rheology and Texture in Food Quality</td>
</tr>
<tr>
<td>M.A. Amerine</td>
<td>Principles of Sensory Analysis of Food</td>
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EFT-703: TECHNOLOGY OF ANIMAL FOODS

UNIT -I
Ante-mortem examination of meat animals, Scientific slaughtering; Meat cuts and portions of meat, Post mortem changes in meat; Conversion of muscle to meat; Colour of meat; composition and nutritional value, Meat microbiology and safety.

UNIT -II
Meat processing- curing and smoking; Fermented meat products (sausages and sauces); Frozen meat & meat storage. Beef Mutton, Pork Sausages and other meat products.

UNIT -III

UNIT -IV
Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish. Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of fish. Methods of processing and preservation of fish- Canning, Freezing, Drying, Smoking and Curing. Fish products – fish meal, fish protein concentrate, fish liver oil, fish sauce and surimi; Fish processing industries in India.

UNIT -V
Meat plant hygiene – GMP and HACCP. By-products from meat industries and their utilization; Meat industries in India. Production of chitin, chitosan; Production of non-food items from fish processing wastes. Byproduct Utilization – commercial processing of lecithin and other egg solids, Utilization of egg-derived products as food ingredients; Fertilizer from shells.

Book References:

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
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<tbody>
<tr>
<td>R.A.Lawrie</td>
<td>Meat Science.</td>
</tr>
<tr>
<td>G.J.Mountney</td>
<td>Poultry Products Technology</td>
</tr>
<tr>
<td>Processed Meats; Pearson AM &amp; Gillett TA; 1996, CBS Publishers.</td>
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<tr>
<td>Meat; Cole DJA &amp; Lawrie RA; 1975, AVI Pub.</td>
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</table>
ECH 702: PLANT DESIGN AND ECONOMICS

UNIT- I
Process Development

Plant Design
Design basis ,Process selection -Selection of equipment, specification and design of equipment’s, material of construction, Plant location, Plant layout and installation, Safety, Start up, Shutdown and Operating guidelines. [8]

UNIT- II
Cost Engineering
Time value of money and equivalence, Interest, cost comparisons by present worth, Annual equivalent cost and capitalised cost methods, Uniform gradient and series. Depreciation, Taxes and Insurances Nature of depreciation, Methods of determining depreciation, depreciation rates in current Indian situation, Types of taxes and insurance’s, Procedure for cost comparison after taxes. [8]

UNIT- III
Cost Estimation
Types of cost estimation, capital investment cost, fixed capital cost, working capital cost, start-up costs, process equipment cost estimation, cost index, Equipment costs due to inflation, Battery limit investments, estimation of plant cost, Estimation of total product cost, Manufacturing cost, General expenses.

Profitability
Criteria of profitability, Payout period, Return on investment, Present value, Cash flow analysis, Alternative investment analysis, Sensitive analysis in project profitability. [8]

UNIT- IV
Economic Optimization and Optimum Design
Nature of optimization, Uni-variable and multivariable systems, Analytical, graphical and incremental methods of solution, LaGrange multiplier method, Linear programming and dynamic programming establishing optimum conditions, Break even chart for production schedule, Optimum production rates in plant operation, Optimum conditions in batch, cyclic and semicyclic operation, Sensitivity and response analysis.

UNIT- V
Optimization of Different Process Equipment
Viz., transportation systems, heat exchangers, evaporators, mass transfer equipments and reactors. Determination of height and diameter of different process equipments at conditions of optimum cost .Pinch Technology analysis. Preparation of techno-economic feasibility report. [8]
EFT-751: FOOD QUALITY EVALUATION LAB  

1. Sensitivity tests (Threshold/Dilution) to measure individual ability for sensory analysis.
2-3. Difference tests to evaluate qualitative and quantitative differences and/or preference between test products.
4-5. Assessment of quality of wheat flour (Water Absorption Power, Gluten Content, and Sedimentation Value etc.).
6. Evaluation of quality of Bakery Products: Bread, Biscuits, Cakes etc.
7-8. Evaluation of quality of Dairy Products: Over run and fat content in Ice-cream, Specific gravity of Milks etc.
9-10. Assessment of quality of Fruit & Vegetable Products: Tomato Products, Jam, Jelly, Marmalades, Squashes & Cordials, Canned Products.

Book References:
1. BIS Specifications Morris B. Jacobs The Chemical Analysis of Foods & Food Products
2. S. Ranganna Hand Book of Analysis and Quality Control for Fruit & Vegetable Products
3. Official Method of Analysis of AOAC

EFT-751: ADVANCED FOOD PROCESSING LAB II  

1. Fermentation & Fermented products like vinegar, cider etc.
2. Preparation of extruded foods.
3. Preparation of different vegetable based instant soups.
4. Preparation of hard boiled candy/tuti-fruity etc.
5. Preparation of food products from tropical fruits as sapota, karonda, ber, anola, mjamun etc.
6. Preparation of instant mixes based on cereal & pulses like Halwa mix, Dosa mix, Idli mix etc.
7. Preparation of egg powder.
8. Analysis of milk.
9. Analysis of Ghee- RM value, Boudomin’s Test and other test for adulteration.
10. Analysis of Egg quality.

EFT-753: PROJECT  

The student(s) will be required to search literature pertaining to design of an equipment / processing of a food commodity / production of food product, comprehend it and prepare a report for assessment.
EFT-754: INDUSTRIAL TRAINING

The student(s) will be required to undertake training in the food industry after III B.Tech.VI semester for a specified period and submit its report after completion for evaluation and oral examination in the VII semester of his studies in Final B.Tech.

EOE-081: NON-CONVENTIONAL ENERGY RESOURCES

UNIT-I
Introduction: Various non-conventional energy resources - Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-II

UNIT-III

UNIT-IV
Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of energy conversion systems.

UNIT-V

Text/References Books:
1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
EOE-082: NON-LINEAR DYNAMIC SYSTEMS

UNIT-I
Dynamic systems: Concept of dynamic systems, importance of non-linearity, nonlinear dynamics of flows (in 1, 2, and 3 dimensions) and Maps (1 and 2 dimensions) in phase space, Equilibrium, Periodicity. Picard’s theorem, Peano’s theorem, boundedness of solutions, omega limit points of bounded trajectories.

UNIT-II
STABILITY-I: Stability via Lyapunov’s indirect method, converse Lyapunov functions, sublevel sets of Lyapunow functions, Lasalle’s invariance principle.

UNIT-III
Stability-II Lyapunov’s direct method, converse Lyapunov’s theorems, Brokett’s theorem, applications to control system, stable manifold theorem, centre manifold theorem, normal form theory and applications to nonlinear systems.

UNIT-IV
Bifurcation: Elementary Bifurcation theory, catastrophe, strange attractor, fractals, fractal geometry and fractal dimension.

UNIT-V
Chaos: Deterministic Chaos, routes to chaos (period doubling, quasiperiodicity, intermittency, universality, renormalization); Measurement of Chaos (Poincare section, Lyapunov index, entropy); control of chaos.

Reference Books:

EOE-083: PRODUCT DEVELOPMENT

UNIT-1
Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., need based developments, technology based developments physical reliability & economic feasibility of design concepts.

UNIT-II
Morphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional, aesthetics, ergonomics, form, shape, size, colour. Mental blocks, Removal blocs, Ideation techniques, Creativity, Check list.
UNIT –III
Transformations, Brainstorming & Synetics, Morphological techniques. Utility Concept, Utility Value, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.

UNIT-IV

UNIT-V
Existing techniques, such as work-study, SQC etc. for improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.

Text/Reference Books:
1. A.K. Chitab& R.C. Gupta “Product design & Manufacturing” – Prentice Hall (EE)
2. R.P. Crewford, ”The Technology of creation Thinking” Prentice Hall.

EOE-084: AUTOMATION AND ROBOTICS

UNIT 1.
Introduction: Definition, Classification of Robots, geometric classification and control classification.

UNIT 2.
Robot Elements: Drive system, control system, sensors, end effectors, gripper actuators and gripper design.

UNIT 3.
Robot Coordinate Systems and Manipulator Kinematics: Robot co-ordinate system representation, transformation, homogenous transform and its inverse, relating the robot to its world. Manipulators Kinematics, parameters of links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control, advanced techniques of kinematics and dynamics of mechanical systems, parallel actuated and closed loop manipulators.

UNIT 4.
Robot Control: Fundamental principles, classification, position, path velocity and force control systems, computed torque control, adaptive control, Seroo system for robot control, and introduction to robot vision.

UNIT 5.
Robot Programming: Level of robot programming, language based programming, task level programming, robot programming synthesis, robot programming for welding, machine tools, material handing, assembly operations, collision free motion planning.

UNIT 6.
Applications: Application of robot in welding, machine tools, material handling, assembly operations parts sorting and parts inspection.

Text/Reference Books:
2. Y. Koren “Robotics for Engineers” Mcgraw Hill.
EFT-011: FOOD PROCESSING WASTE MANAGEMENT

UNIT -I
Basic considerations: Standards for emission or discharge of environmental pollutants from food processing Industries as per the updated provision of Environment (Protection) Act, 1986. Elements of importance in the efficient management of food processing wastes.

UNIT -II
Characterization and utilization of by-products from Cereal Pulses, Oilseeds, Fruits and vegetables, Plantation products, Fermented foods, Milk, Fish, Meat, Egg and poultry processing industries.

UNIT -III
Characterization of food Industry effluents, Physical an chemical parameters, Oxygen demands and their interrelationships, Residues (solids), Fats, Oils and grease, Forms of Nitrogen, Sulphur and Phosphorus, Anions and cations, Surfactants, Colour, Odour, Taste, Toxicity. Unit concept of treatment of food industry effluent, Screening, Sedimentation Floatation as pre - and primary reactants.

UNIT -IV
Biological oxidations: Objects, Organisms, Reactions, Oxygen requirements, Aeration devices Systems: Lagoons, Activated sludge process, Oxidation ditches, Rotating biological cont caters and their Variations and advanced modifications.

UNIT -V

Book References:
J.H. Green Food Processing Waste Management
Environment (Protection) Act
AFST(I) & CFTRI Proceedings of the Symposium on By-products From food Industries: Utilization and Disposal

EFT-012: RHEOLOGICAL AND SENSORY ANALYSIS OF FOODS

UNIT -I
Mechanical properties of foods. Mechanical models to visualize behaviour of foods. Basic and applied rheological considerations and their application to foods.

UNIT -II

UNIT -III
Requirement of test systems for measuring food texture. Types of texture Instrument and their operating mechanisms, Calibration, Performance of test and measurements of test parameters. Interpretation of test results.

UNIT -IV
Textural properties of fruits & vegetables; Dough, Pasta and Baked products; dairy products; Meat; Fat and fat products; and their instrumental Measurements.

UNIT -V
Rheology of chocolate, Textural characteristics of food emulsions, Functions of emulsifiers in relation to food texture, Sensory measurement of food texture and texture profile.

Book References:
J.M. de Man Rheology and Texture in Food quality

EFT-013: FOOD PHYSICS

UNIT I-PHYSICAL PROPERTIES
Engineering properties - importance and applications in the crop process equipment design. Physical characteristics - shape, size, volume, bulk density, particle density, porosity, Surface area. Frictional characteristics- angle of repose, co-efficient of friction - determination.

UNIT II-RHEOLOGICAL PROPERTIES

UNIT III- TEXTURAL PROPERTIES
Texture of food materials - subjective and objective methods - Imitative and Empirical tests . Texture Profile Analysis.Interpretation of results.

UNIT IV-THERMAL PROPERTIES

UNIT V-ELECTRICAL AND AERODYNAMIC PROPERTIES

TEXT BOOKS

EFT-021: FOOD PRODUCT AND PROCESS DEVELOPMENT

UNIT -I
UNIT -II
Detailed study of product, process and market, Planning and developmental activities and evaluating them.

UNIT -III
Development of prototype product and its testing for acceptance.

UNIT -IV
Development of process and planning for production trials. Planning the test market. Actual production trials and test marketing. Evaluation of test results.

UNIT -V
Launching of the product. Advertising and marketing plans. Suggestions for improving success.

Book References:
Chicago: Arlington Food Product Development

EFT-022 : SPECIALITY FOODS

UNIT -I

UNIT -II
Foods / Diets in metabolic disorders and disturbances.

UNIT -III
Foods and Diets recommended and restricted in Gastrointestinal disorders; Fever and Infection; Liver, gallbladder and pancreatic disturbances.

UNIT -IV
Foods and Diets recommended and restricted in blood, circulatory and Cardiac diseases; urinary and Musculoskeletal diseases. Allergies.

UNIT -V
Beneficial Effects of Spices, gamma-linolenic acid, Spirulina, antioxidants and other food constituents. New Developments.

Book References:

Author Title
Benzamin T. Burton Human Nutrition
Shubhangini A. Joshi Nutrition and Dietetics
B. Srilakshmi Dietetics
Arnold E. Bender Nutrition and Dietetic foods
AFST(I) & CFTRI Proceedings of IFCON 98
Periodicals by AFST(I), CFTRI Indian Food Industry
P. S. Howe, W.B. Saunders Basic Nutrition in Health & Disease
EFT 023 : ENGINEERED, TEXTURISED & FABRICATED FOODS

UNIT I

UNIT II
Textured vegetable protein products. Puffing Gun, Puffed Products. Meat Analogues., Imitation Paneer

UNIT III
Fabricated RTS Beverages, Bakery Products, Margarine, Peanut Butter, Imitation Milks Designer Lipids etc.

UNIT IV

UNIT V
Technology and manufacture of Macaroni, Pasta, Noodles, Vermicelli etc

EFT- 801 : TRADITIONAL AND FERMENTED FOODS

UNIT -I
Indian traditional sweet, savory and snack food products: Sweetmeats,Namkins, Papads Idli and Dosa.

UNIT -II
Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

UNIT -III

UNIT -IV

UNIT -V

Book References:
K.H. Steinkrus Handbook of Indigenous Fermented Foods
Sukumar De Outlines of Dairy Technology
Prescott & Dunn Industrial Microbiology
L.E. Casida Industrial Microbiology

EFT-751 PROJECT

The student(s) will be required to prepare a detailed project report on fabrication of an equipment / establishment of a plant for processing of a food commodity for production of food product(s) with complete lay-out and economic analysis for assessment.