Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Chemistry-II	
Course Code: BS-FT 301	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points:3	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of students in the properties of dilute solutions using colligative properties, ionic equilibrium
2	To enable the students to explain the formation, characteristics and application of colloidal solutions
3	To enable the students to explain the shape, properties and bonding of ionic, covalent and coordination compounds
4	To prepare the students to explain kinetics of reactions and mechanism of organic reactions
Pre-Requisite:	
1	Basic physical, inorganic and organic chemistry

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	**Module I: Dilute solutions –** **Colligative properties:** Lowering of vapor pressure of solution, elevation of boiling point, freezing point depression, definition, principles, and laws of osmotic pressure **Ionic equilibrium:** Solubility and solubility product, common ion effect, determination of solubility product by EMF method, ionic product of water, pH, pOH, hydrolysis of salt solutions: Strong acid and weak base, weak acid and strong base, weak acid and weak base, concepts of buffer	8	
2	**Module II:** **Coordination chemistry:** Structures of coordination compounds corresponding to coordination number 6; types of ligands; isomerism(geometrical, optical, ionization, linkage and coordination) **Colloid chemistry:** Definition of colloid, principle of colloid formation, types of colloid, colloid preparation, stability of colloid, association of	8	

	colloid and emulsion		
3	**Module III:** **General treatment of reaction mechanisms:** Ionic and radical reactions; heterolytic and, homolytic bond cleavage. **Reactive intermediates:** carbocations (carbenium and carbonium ions), carbanions, carbon radicals –structure using orbital picture, electrophilic/nucleophilic behaviour, stability, generation and fate. Fundamentals of elimination, substitution, addition and rearrangement – Definition and organic reactions.	7	
4	**Module IV:** **Structure and bonding:** Ionic and covalent bonding, M.O. and V.B. approaches for diatomic molecules, VSEPR theory and shape of molecules, hybridization, resonance, dipole moment, structure parameters such as bond length, bond angle and bond energy, hydrogen bonding, vander Waals interactions. Ionic solids, ionic radii, lattice energy (Born-Haber Cycle).	7	
5	**Module V:** **Kinetics:** Rate of Chemical reactions, Order and Molecularity of chemical reactions, Elementary and Non elementary reactions. First, second and third order reactions. Pseudo-first order reaction. Fractional order reactions. Determination of order and rate constant by integral and half-life method. Effect of rate constant on temperature: Arrhenious equation. Collision theory, Transition state theory.	6	

Text and Reference Books:

TEXT

1. Physical Chemistry by P. C. Rakshit, Sarat Book House
2. Inorganic Chemistry by R. L. Madan, G. D. Tuli, S.Chand& Company Ltd
3. Organic Chemistry by Dr. R.L.Madan, S.Chand& Company Ltd

REFERENCE

1. Physical Chemistry, by P. W. Atkins
2. Inorganic Chemistry 4th Ed: principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi
3. Mechanism in Organic Chemistry by Peter Sykes, orient Longman Pvt. Ltd.
4. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition
5. Engineering Chemistry by Jain and Jain
6. Engineering Chemistry by Manisha Agarwal, Khanna Publishing House, 2018.

Course Outcome:

After completion of the course the students will be able to

1. **Apply** the knowledge of colligative properties and ionic equilibrium to determine the chemical parameters of dilute solutions

2. **Identify** the molecular geometries, magnetic properties and isomerism in coordination compounds based on the specific ligands.

3. **Explain** the principle, properties and application of colloids

4. **Identify** the products formed and explainthe reaction mechanism ofsubstitution, elimination, addition and rearrangement reactions

5. **Explain** the shape, bonding, structural parameters and physical properties of molecules in the light of V.B., M.O. and VSEPR theory

6. **Apply** the integrated rate laws to determine order, rate constant, activation energy of chemical reactions

Special Remarks (If any):

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Name of the Course: Engineering Thermodynamics	
Course Code: ES-FT 301	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1	To develop the fundamental knowledge of students in the area of Engineering Thermodynamics
2	To depict the theory and applications of laws of thermodynamics and thermodynamic properties
Pre-Requisite:	
1	Chemistry
2	Mathematics

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Fundamentals of thermodynamics (System, heat, work, internal energy, entropy, first law), and its practical significance/applied to elementary processes Limitations of the first law of thermodynamics, Second law, concepts of heat engines and heat pumps, refrigeration, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Carnot cycle and Carnot principles/theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; the principle of increase of entropy, T-s diagrams; second law analysis of control volume; availability and irreversibility; Third law of thermodynamics		
2	Properties of Pure Substances Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-v- T behaviour of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, ideal gas equation of state and van der Waals equation of state; law of corresponding states, compressibility factor. Analysis of non- flow and flow processes for an ideal gas under constant volume (Isochoric), constant pressure (isobaric), constant temperature (isothermal), adiabatic		

	and polytropic conditions. Ideal Gas Mixtures Dalton's and Amagat's laws, properties of ideal gas mixtures, air-water vapour mixtures and simple thermodynamic processes involving them; specific and relative humidities, dew point and wet bulb temperature, adiabatic saturation temperature, psychrometric chart.		
3	Thermodynamic Relations T-ds relations, Helmholtz and Gibbs functions, Gibbs relations, Maxwell relations, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibilities, Clapeyron and Clapeyron-Clausius equations. Thermodynamic and power Cycles Carnot vapor cycle, ideal Rankine cycle, Rankine reheat cycle, vapor-compression refrigeration cycle.		
4	Thermodynamics of fluid flow; Study of different types of boilers; Brief idea of hydraulic power plants		

Text and Reference Books:

TEXT

1. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH

REFERENCE

1. Richardson, J.F., Peacock, D.G.Coulson & Richardson's Chemical Engineering- Volume 3ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Levenspiel.O., Chemical Reaction Engineering, Wiley Eastern Ltd.
3. Bailey & Olis,Biochemical Engg. Fudamentals, MGH, 1990
4. Physical Chemistry: Castellan, Narosa Publishing.
5. Physical Chemistry ;Moore, PHI

Course Outcome:

After completion of the course the students will be able to

1. Understand the basic concept of thermodynamic system.

2. Explain the laws of thermodynamics and their applications

3. Comprehend the properties of pure substances and real gases.

4. Analyze the different thermodynamic relations and their applications.

5. Evaluate the fundamentals of Thermodynamics of fluid flow.

6. Understand the working of different types of boilers and hydraulic power plants.

Special Remarks (If any):

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Name of the Course: Unit Operation _I (Mechanical Operations and Separation Process)	
Course Code: ES-FT 302	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: 1 hrs./ week	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 4	End Semester Exam: 70 Marks

Objective:	
1	Recall different material balance and energy balance equation to conceptualize the experiments.
2	To assess the different simultaneous mass and energy transfer operation in industrial process like drying crystallisation etc.
3	To apply their knowledge in membrane separation process.
4	To understand different type of Mechanical operations like crushing and Grinding and Sieve separation technique
5	To understand the Engineering operations in different mixing process solid- solid mixing and liquid liquid mixing etc.
6	To understand different type of pressure filtration process and rate of filtration, constant pressure and Rate filtration
Pre-Requisite:	
1	At least 45 units of undergraduate study in a particular profession

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Size Reduction: Principles of comminution, Types of comminuting equipment. Energy and power requirement, Crushers, Grinders, Principles and types of size reduction equipment, disintegration of fibrous materials;	9	
2	Mixing: Mixing of liquids and solids (powder), mixing equipment,	12	

	mixing index and mixing time, Agitation and blending, types of agitators, power consumption in mixing. Mechanical separation, Screening, Types of screen, Filtration, Principle of Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal separations Centrifugation: Principle of settling, sedimentation, flocculation, devices and types of each operation (free and hinderd settling, hydraulic separation and heavy media separation)		
3	Material balance: Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification, continuous filtration, batch mixing, crystallizer, distillation column. Material balance with chemical reaction: Stoichiometry of growth and product formation: growth stoichiometry and elemental balances.	10	
4	Material Balance with recycle, bypass and purge streams its application in Food and Biochemical Industries	4	
5	Crystallization: material and energy balance calculations and introduction to crystallizer design. Fundamental principles of liquid-liquid extraction, selectivity and choice of solvent; material balances in stage operations and principles of graphical methods in determination of number of equilibrium stages; Fundamental principles of leaching operation and material balance calculations.	7	

Text and Reference Books:

1. Revision: 5L

Books:

1. Unit Operations of Chemical Engineering: McCabe, Smith &Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
8. Fundamentals of Food Process Engineering R.T. Toledo CBS publication
9. Food Processing Technology P.J. Fellows CRC press

Course Outcome:

After completion of the course the students will be able to

CO1: Understand different disintegration process in Food Industries

CO2 : realize different Industrial Mixing process and power consumption in Mixing

CO3 : Make use of of design of different type of settling tank by applying the principle of setting.

CO4 : Different type of material and Energy balance in different Food Processing operations

CO5: Application of Material Balance principle in case of Microbial growth

CO6 : They can understand different types of crystallization process like candy preparation etc.

Special Remarks (If any): To understand different mechanical operation, To understand different Food processing operation and how material and energy balance principle is maintained in Food processing operations. Understanding of cold sterilization through membrane separation process.

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(Applicable from the academic session 2018-2019)

Name of the Course: Chemistry of Food	
Course Code: PC-FT 301	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: 1 hrs./ week	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 4	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of students in the basic area of Food Chemistry
2	To enable the students to appreciate the similarities and complexities of the chemical components in foods and understanding of the physicochemical properties of foods.

Pre-Requisite:	
1	Basic physical and organic chemistry
2	Bio-molecules

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	**Introduction:** Development of food chemistry and its importance in food processing, different food groups, function of foods	1	
2	**Water:** Importance of water in foods; Structure of water and ice; Crystallization & glass transition; Concept of bound & free water and their implications; Water activity (concepts, sorption phenomenon & isotherms, hysteresis); Role of water in food spoilage & food safety; Moisture determination methods.	5	
3	**Carbohydrate:** Nomenclature, classification & physico-chemical properties (oxidation, reduction, hydrolysis etc.); Structure and functionalities of important monosaccharides (glucose, fructose, galactose), disaccharides (sucrose, lactose, maltose) and polysaccharides (starch, cellulose, glycogen, hemi-cellulose, pectic substances, gums, dietary fiber, inulin etc.); Basic idea about Gelatinization, Retrogradation, Crystallization, Caramelization, Mutarotation.	9	
4	**Proteins:** Nomenclature, classification & structure of amino acids, peptides & proteins; Physico-chemical and functional properties of proteins (hydration, solubility, denaturation, texturization etc.);	9	

	Purification, separation & isolation of proteins; Common food proteins; Qualitative and quantitative determination of proteins.		
5	**Browning reactions:** Enzymatic and non-enzymatic browning, advantages and disadvantages, factors affecting their reaction and control	3	
6	**Lipids:** Nomenclature, classification & structure of fatty acids and lipids; Importance of PUFA, omega-3 & omega-6 fatty acids, trans fatty acids, phospholipids & sterols in human diet; Physical constants (melting, solidification, softening, turbidity, smoke, flash & fire points) & chemical constants (saponification number, iodine value, Reichert-Meissl number, Polenske number, acid value, peroxide value); Rancidity and their prevention; Basic idea about polymorphism, hydrogenation, interesterification, winterization, refining; Dietary sources of lipids	10	
7	**Vitamins:** Types, sources and deficiency diseases of vitamins; Pro-vitamins; Vitamins as antioxidants; Effect of processing and storage.	5	
8	**Minerals:** Types, sources and deficiency diseases of important minerals; Effect of processing and storage; Importance of minerals in milk, meat etc.	3	

Text and Reference Books:

TEXT

4. Principles of Food Chemistry by John M. deMan, Third Edition. Aspen Publication, Gaithersburg, Maryland
5. Food Chemistry by L. H. Meyer, CBS Publishers and Distributors
6. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Narosa, 2010.

REFERENCE

7. Hand Book of Analysis and quality control for fruits & vegetables by S. Ranganna, 2nd edn. Tata Mc. Graw Hill Publication, New Delhi, India.
8. Food Chemistry by O. R. Fennema, Third Edition, Marcel Dekker, Inc., New York
9. Food chemistry by Belitz H.D., Grosch W. and Schieberle, Third Edn., Berlin: Springer Verlag
10. Principles of Biochemistry by Lehninger, Nelson & Cox, CBS Publication
11. Principles of Biochemistry by D. J. Voet, J. G. Voet and C.W. Pratt, Third Edn., Wiley.

Course Outcome:

After completion of the course the students will be able to

1. Understand and identify the various food groups; the nutrient components (macro and micro), proximate composition etc.

2. Understand and identify the non-nutritive components in food, naturally present.

3. Explain the chemistry underlying the properties and reactions of various food components.

4. Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition

5. Analyze how the properties of different food components and interactions among these components modulate the specific quality attributes of food systems.

6. Develop solutions to reduce the interference of major chemical reactions during food processing that are likely to impact the overall quality of finished products.

Special Remarks (If any):

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Syllabus for B. Tech in Food Technology

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Name of the Course: Food Microbiology	
Course Code: PC-FT 302	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: 1 hrs./ week	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 4	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of students in the basic area of Food Microbiology
2	To recognize and describe the characteristics of important pathogens and spoilage Microorganisms, and few beneficial microorganisms in food
3	To identify the effect of microbial contamination in food and how to examine microbial load
Pre-Requisite:	
1	Biology

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	Introduction – definition, historical development and significance of food microbiology; Factors affecting microbial profile of foods, Microbiology of air & water; Techniques of pure culture; Methods for the microbiological examination of water and foods	9	
2	Food borne illnesses and diseases- Current Scenario. Basic idea about Microbial Toxin. Antimicrobial agents –physical & chemical – mechanism & action. Disinfection & disinfectants; Control of Microbiological quality and safety	12	
3	Concepts of spoilage, pathogenic and beneficial microbes; probiotics and synbiotics, Microbiology of milk & milk products (cheese, butter, ice-cream, milk powder); Microbiology of meat, fish, poultry & egg and their products.	12	
4	Microbiology of fruits & vegetable and products like jam, jelly, sauce, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary.	12	

Text and Reference Books:

TEXT

2. Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi
3. Modern Food Microbiology; James M Jay; CBS Publishers, Delhi
4. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, Delhi
5. Food Microbiology; M. R. Adams

REFERENCE

1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers, Delhi
2. Hand Book of Microbiology; Bisen
3. Basic Food Microbiology; Bannett, Chapman and Hall
4. Bibek Ray. "Fundamental food microbiology". CRC Press. 3rd Edition. 2005.

Course Outcome:

After completion of the course the students will be able to

1. Identify and note the types of microorganisms inhabiting different categories of food
2. Understand the interactions between microorganisms and the food environment, and factors influencing their growth and survival
3. Describe the characteristics of food-borne, waterborne microorganisms, and methods for their isolation, detection and identification
4. Analyze how beneficial species of microorganisms can be utilized in the food industry.
5. Evaluate how microbial spoilage leads to food-borne illnesses and how they can be controlled.
6. Develop basic microbiological quality control solutions necessary in food production, handling and storage.

Special Remarks (If any):

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Name of the Course: Biology for Engineers	
Course Code: BS-FT 302	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of students in the fundamentals of biological sciences and microbiology
2	To enable the students to develop an insight in cellular structure and life processes of microbes
3	To apprise the students about natural products i.e. flavor and pigments (used as food additives) with their synthesis, properties
Pre-Requisite:	
1	Fundamentals of classical biology
2	Organic chemistry

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Introduction to Biology**;** Prokaryotic and Eukaryotic cell; Architecture of plant/animal/microbial cell ;	2	
2	Basics of cell biology – Different cell organelles – cell wall, cell membrane, nucleus, mitochondria, Golgy body, endoplasmic reticulum, vacuoles etc.	4	
3	Classification of microbes: Morphology and characteristics of each type; microbial cell metabolism, metabolic enzymes	6	
4	Microbial Respiration, Growth and Reproduction	6	
5	Basics of microbial genetics – Gene, DNA, RNA, Replication, transcription, transformation, transduction, conjugation, regulation of gene expression	4	
6	Natural products from plant/animal/microbial origin – Plant pigments (water-soluble, fat-soluble pigments): sources, properties, chemical identity, changes	6	
7	Animal pigments, microbial pigments; sources, properties, chemical identity,	6	

	changes in processing		
8	Natural flavouring agent from plant/animal origin – definition, extraction/synthesis, purification (if required), flavor enhancers	6	

Text Books:

TEXT

7. Fundamentals of Biology : Sanyal and Chatterjee,
8. Food Chemistry by L. H. Meyer, CBS Publishers and Distributors
9. Biology for Engineers – R. Singhal, Gaurav Agarwal and Ritu bir ; CBS publishers
10. Microbiology – Pelczar,Chan and Krieg; McGraw-Hill Inc.,US

Course Outcome:

After completion of the course the students will be able to

1. Differentiate the features of microbial cell against plant/animal cell.
2. Understand the characteristic life-processes of microbial cell .
3. Identify different types and/or forms of microbes.
4. Classify different plant/animal/microbial pigments correlating with structure and properties.
5. Illustrate synthesis of flavor as natural products from natural source.

Special Remarks (If any):

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Chemistry of Food Lab	
Course Code: PC-FT 391	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	Understand the physical and chemical properties of food
2	Understand different methods of analysis of food components
3	Compare different methods available for analysis of particular food component
4	Understand and use effectively, food composition tables and databases to solve practical problems
5	Analyze effectively the data to reach reasonable and valid conclusion
6	Design appropriate methods for food composition analysis in real situation

Pre-Requisite:	
1	Handling of glasswares, chemicals and equipments
2	Basic knowledge of solution preparation, chemical reactions
3	Spectrophotometric , titrimetric, gravimetric, volumetric principles

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, pH meter, Hot Air Oven/ Moisture Analyzer, Soxhlet Apparatus, Kjeldhal Unit, Muffle Furnace Glasswares, chemicals & consumables

Laboratory Experiments:	
1	Determination of Moisture in food sample
2	Determination of Acidity and pH in food sample/beverages
3	Determination of total, non-reducing and reducing sugars
4	Determination of Protein in food sample
5	Determination of Crude Fat in food sample
6	Determination of Ash in food sample
7	Estimation of calcium/ zinc/ iron in food sample
8	Determination of Vitamin C in food sample
9	Determination of pigments in food sample

Text and Reference Books:

1. FSSAI Manuals
2. Handbook of analysis & quality control for fruit & vegetable products by S. Rangana, II ed., Tata McGraw Hill Publishing Co., New Delhi
3. ISI Handbook of Food Analysis
4. Official methods of analysis of AOAC

Special Remarks (If any): Nil

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Microbiology of Food Lab	
Course Code: PC-FT 392	**Semester: III**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva -20 Marks

Objective:	
1	Understand the microbiological load of food and beverage samples
2	Understand different microbiological methods of food components
3	Compare different microbiological standards available for analysis of particular food component
4	Understand and use effectively, microbiological techniques to standardize quality to solve practical problems
5	Analyze effectively the data to reach reasonable and valid conclusion
6	Design appropriate SOPs for microbiological analysis of food in real-time situation
Pre-Requisite:	
1	Handling of glasswares, chemicals and equipments
2	Basic knowledge of solution preparation, biology, yeast and mould growth, bacterial growth, pathogen, pasteurization, sterilization
3	Spectrophotometric principles, Laminar air flow cabinet, Microscope, Autoclave

Practical:	
	1) Intellectual skills-
	2) Motor skills- Autoclave, Spetrophotometer, Laminar air flow cabinet, Microscope, , pH meter, Hot Air Oven/ Moisture Analyzer, Petri plate use Glasswares, chemicals & consumables

Laboratory Experiments:	
1	Study of a compound microscope.
2	Gram Staining and Study of morphology of bacterial cells
3	Study of autoclave, Preparation and sterilization of nutrient broth and agar
4	Sub-culturing and isolation of a bacterial strain
5	Study of growth of E. coli by a spectrophotometer
6	Study of microbiological quality of milk by MBRT test
7	Preparation of synthetic medium for yeast and mould and inoculation with standard strains of

	yeasts and moulds
8	Isolation of starch-hydrolyzing organism from soil
9	Dilution and Plating by spread–plate, streak-plate and pour –plate techniques
9	Determination of pigments in food sample
10	Isolation of pure culture
11	Estimation of microbial count of air, water and soil
12	Growth of Yeast and Mold in synthetic media and their Morphological Identification
13	Preparation of Culture Slants for preservation of Culture

Text and Reference Books:

1. FSSAI Manuals
2. ISI Handbook of Food Analysis
3. Official methods of analysis of AOAC
4. Laboratory Manual of Food Microbiology, Neelima Garg, K L Garg & K.G. Mukerji
5. Handbook of analysis & quality control for fruit & vegetable products by S. Rangana, II ed., Tata McGraw Hill Publishing Co., New Delhi

Special Remarks (If any): Nil