GUJARAT TECHNOLOGICAL UNIVERSITY

ADVANCE ENGINEERING MATHS
SUBJECT CODE: 2130002
B.E. 3RD SEMESTER

Type of course: Engineering Mathematics

Prerequisite: The course follows from Calculus, Linear algebra

Rationale: Mathematics is a language of Science and Engineering

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction to Some Special Functions:** Gamma function, Beta function, Bessel function, Error function and complementary Error function, Heaviside's function, pulse unit height and duration function, Sinusoidal Pulse function, Rectangle function, Gate function, Dirac's Delta function, Signum function, Saw tooth wave function, Triangular wave function, Halfwave rectified sinusoidal function, Full rectified sine wave, Square wave function.	02	4
2	**Fourier Series and Fourier integral:** Periodic function, Trigonometric series, Fourier series, Functions of any period, Even and odd functions, Half-range Expansion, Forced oscillations, Fourier integral	05	10
3	**Ordinary Differential Equations and Applications:** First order differential equations: basic concepts, Geometric meaning of $y' = f(x,y)$ Direction fields, Exact differential equations, Integrating factor, Linear differential equations, Bernoulli equations, Modeling , Orthogonal trajectories of curves.Linear differential equations of second and higher order: Homogeneous linear differential equations of second order, Modeling: Free Oscillations, Euler- Cauchy Equations, Wronskian, Non homogeneous equations, Solution by undetermined coefficients, Solution by variation of parameters, Modeling: free Oscillations resonance and Electric circuits, Higher order linear differential equations, Higher order homogeneous with constant coefficient, Higher order non homogeneous equations. Solution by [1/f(D)] r(x) method for finding particular integral.	11	20
4	**Series Solution of Differential Equations:** Power series method, Theory of power series methods, Frobenius method.	03	6
5	**Laplace Transforms and Applications:** Definition of the Laplace transform, Inverse Laplace transform, Linearity, Shifting theorem, Transforms of derivatives and integrals Differential equations, Unit step function Second shifting theorem,	09	15

	Dirac's delta function, Differentiation and integration of transforms, Convolution and integral equations, Partial fraction differential equations, Systems of differential equations		
6	**Partial Differential Equations and Applications:** Formation PDEs, Solution of Partial Differential equations f(x,y,z,p,q) = 0, Nonlinear PDEs first order, Some standard forms of nonlinear PDE, Linear PDEs with constant coefficients,Equations reducible to Homogeneous linear form, Classification of second order linear PDEs.Separation of variables use of Fourier series, D'Alembert's solution of the wave equation,Heat equation: Solution by Fourier series and Fourier integral	12	15

Reference Books:

1. Advanced Engineering Mathematics (8th Edition), by E. Kreyszig, Wiley-India (2007).
2. Engineering Mathematics Vol 2, by Baburam, Pearson
3. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005)
4. R. V. Churchill and J. W. Brown, Fourier series and boundary value problems (7th Edition), McGraw-Hill (2006).
5. T.M.Apostol, Calculus , Volume-2 (2nd Edition), Wiley Eastern , 1980

Course Outcome:

After learning the course the students should be able to

1. Fourier Series and Fourier Integral
   - Identify functions that are periodic. Determine their periods.
   - Find the Fourier series for a function defined on a closed interval.
   - Find the Fourier series for a periodic function.
   - Recall and apply the convergence theorem for Fourier series.
   - Determine whether a given function is even, odd or neither.
   - Sketch the even and odd extensions of a function defined on the interval [0,L].
   - Find the Fourier sine and cosine series for the function defined on [0,L]
2. Ordinary Differential Equations and Their Applications
   - Model physical processes using differential equations.
   - Solve basic initial value problems, obtain explicit solutions if possible.
   - Characterize the solutions of a differential equation with respect to initial values.
   - Use the solution of an initial value problem to answer questions about a physical system.
   - Determine the order of an ordinary differential equation. Classify an ordinary differential equation as linear or nonlinear.
   - Verify solutions to ordinary differential equations.
   - Identify and solve first order linear equations.
   - Analyze the behavior of solutions.
   - Analyze the models to answer questions about the physical system modeled.
   - Recall and apply the existence and uniqueness theorem for first order linear differential equations.
   - Identify whether or not a differential equation is exact.
   - Use integrating factors to convert a differential equation to an exact equation and then solve.
   - Solve second order linear differential equations with constant coefficients that have a characteristic equation with real and distinct roots.
   - Describe the behavior of solutions.
   - Recall and verify the principal of superposition for solutions of second order linear differential equations.
   - Evaluate the Wronskian of two functions.

- Determine whether or not a pair of solutions of a second order linear differential equations constitute a fundamental set of solutions.
- Recall and apply Abel's theorem.
- Apply the method of reduction of order to find a second solution to a given differential equation.
- Apply the method of undetermined coefficients to solve non-homogeneous second order linear differential equations.
- Model undammed mechanical vibrations with second order linear differential equations, and then solve. Analyze the solution. In particular, evaluate the frequency, period, amplitude, phase shift, and the position at a given time.
- Define critically damped and over damped. Identify when these conditions exist in a system.
- Describe the phenomena of beats and resonance. Determine the frequency at which resonance occurs.
- Recall the definition of linear independence for a finite set of functions. Determine whether a set of functions is linearly independent or linearly dependent.
- Use the method of variation of parameters to solve non-homogeneous higher order linear differential equations.

3. Series Solution of Differential Equations

- Manipulate expressions involving summation notation. Change the index of summation.
- Find the general solution of a differential equation using power series.
- Given an initial value problem, use the differential equation to inductively determine the terms in the power series of the solution, expanded about the initial value.

4. Laplace Transforms and Applications

- Sketch a piecewise defined function. Determine if it is continuous, piecewise continuous or neither.
- Evaluate Laplace transforms from the definition.
- Determine whether an infinite integral converges or diverges.
- Evaluate inverse Laplace transforms.
- Use Laplace transforms to solve initial value problems.
- Convert piecewise defined functions to functions defined in terms of step functions and vice versa.
- Find the Laplace transform of a piecewise defined function.
- Apply the shifting theorems to evaluate Laplace transforms and inverse Laplace transforms.
- Use Laplace transforms to solve differential equations with discontinuous forcing functions.
- Define an idealized unit impulse function.
- Use Laplace transforms to solve differential equations that involve impulse functions.
- Evaluate the Laplace transform of a convolution of functions.
- Use the convolution theorem to evaluate inverse Laplace transforms.

5. Partial Differential Equations and Applications

- Determine the order of a partial differential equation.
- Classify a partial differential equation as linear or nonlinear.
- Verify solutions to partial differential equations.
- Apply the method of separation of variables to solve partial differential equations, if possible.
- Find the solutions of heat conduction problems in a rod using separation of variables.
- Solve steady state heat conduction problems in a rod with various boundary conditions.
- Solve the wave equation that models the vibration of a string with fixed ends.
- Describe the motion of a vibrating string.

- Solve Laplace's equation over a rectangular region for various boundary conditions.
- Solve Laplace's equation over a circular region for various boundary conditions.

List of Open Source Software/learning website:

1. NPTEL
   http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home4.30
   https://www.youtube.com/watch?v=DPg5T-YBQjU
   https://www.youtube.com/watch?v=7fJeo1fylKI
   https://www.youtube.com/watch?v=1FnBPmEWpus
   https://www.youtube.com/watch?v=dgDIQ0VA0pA
   https://www.youtube.com/watch?v=SoBs-YGQUdc
   https://www.youtube.com/watch?v=Fh8m6ZdFaqU

2. **Instructor(s):** Prof. Haynes Miller, Prof. Arthur Mattuck

   http://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/

3. **Instructor:** Prof. Haynes Miller, Prof. Arthur Mattuck, Dr. John Lewis

   http://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICS OF SOLIDS
SUBJECT CODE: 2130003
B.E. 3RD SEMESTER

Type of course: Applied Physics

Prerequisite: System of units
Laws of motion
Basic idea of force
Concept of centroid
Fundamentals of stress, strain and their relationships

Rationale: Mechanics of Solids is conceptual applications of principles of mechanics in Engineering

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Module 1		
1	**Introduction** Definition of space, time, particle, rigid body, deformable body. Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces. Fundamental Principles of mechanics: Principle of transmissibility, Principle of superposition, Law of gravitation, Law of parallelogram of forces.	02	20
2	**Fundamentals of Statics** **Coplanar concurrent and non-concurrent force system:** Resultant, Equilibrant, Free body diagrams. **Coplanar concurrent forces:** Resultant of coplanar concurrent force system by analytical and graphical method, Law of triangle of forces, Law of polygon of forces, Equilibrium conditions for coplanar concurrent forces, Lami's theorem. Application of statically determinate pin – jointed structures. **Coplanar non-concurrent forces:** Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Resultant of non-concurrent forces by analytical method, Equilibrium conditions of coplanar non-concurrent force system, Application of these principles.	08	
	Module 2		
3	**Applications of fundamentals of statics**	08	15

	Statically determinate beams: Types of loads, Types of supports, Types of beams; Determination of support reactions, Relationship between loading, shear force & bending moment**,** Bending moment and shear force diagrams for beams subjected to only three types of loads :i) concentrated loads ii) uniformly distributed loads iii) couples and their combinations; Point of contraflexure, point & magnitude of maximum bending moment, maximum shear force.		
Module 3			
4	**Friction** Theory of friction, Types of friction, Static and kinetic friction, Cone of friction, Angle of repose, Coefficient of friction, Laws of friction, Application of theory of friction: Friction on inclined plane, ladder friction, wedge friction, belt and rope friction.	06	20
5	**Centroid and moment of inertia** **Centroid:** Centroid of lines, plane areas and volumes, Examples related to centroid of composite geometry, Pappus – Guldinus first and second theorems. **Moment of inertia of planar cross-sections:** Derivation of equation of moment of inertia of standard lamina using first principle**,** Parallel & perpendicular axes theorems, polar moment of inertia, radius of gyration of areas. Examples related to moment of inertia of composite geometry,	08	
Module 4			
6	**Simple stresses & strains** Basics of stress and strain: 3-D state of stress (Concept only) Normal/axial stresses: Tensile & compressive Stresses :Shear and complementary shear Strains: Linear, shear, lateral, thermal and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus and relations between them with derivation. Application of normal stress & strains: Homogeneous and composite bars having uniform & stepped sections subjected to axial loads and thermal loads, analysis of homogeneous prismatic bars under multidirectional stresses.	10	20
Module 5			
7	**Stresses in Beams:** **Flexural stresses –** Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T,Angle, channel sections **Shear stresses –** Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.	06	25
8	**Torsion:** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity.	04	

9	**Principle stresses:** Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications	04	
Module –VI			
10	**Physical & Mechanical properties of materials: (laboratory hours)** Elastic, homogeneous, isotropic materials; Stress –Strain relationships for ductile and brittle materials, limits of elasticity and proportionality, yield limit, ultimate strength, strain hardening, proof stress, factor of safety, working stress, load factor, Properties related to axial, bending, and torsional & shear loading, Toughness, hardness, Ductility ,Brittleness	05	50% (Practical) & 0% (Theory)
11	**Simple Machines: (laboratory hours)** Basics of Machines, Definitions: Velocity ratio, mechanical advantage, efficiency, reversibility of machines. Law of Machines, Application of law of machine to simple machines such as levers, pulley and pulley blocks, wheel and differential axle, Single purchase, double purchase crab, screw jacks. Relevant problems.	05	

Course Outcome:

After learning the course the students should be able to:

1. apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering.
2. apply principles of statics to determine reactions & internal forces in statically determinate beams.
3. determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.
4. know basics of friction and its importance through simple applications.
5. understand the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.
6. know behaviour & properties of engineering materials.
7. know basics of simple machines and their working mechanism.

List of Experiments:

The students will have to solve atleast five examples and related theory from each topic as an assignment/tutorial. Students will have to perform following experiments in laboratory and prepare the laboratory manual.

Mechanics of rigid body

1. Equilibrium of coplanar concurrent forces
2. Equilibrium of coplanar non-concurrent forces
3. Equilibrium of coplanar parallel forces: Determination of reactions of simply supported beam
4. Verification of principle of moment: Bell crank lever
5. Determination of member force in a triangular truss
6. Determination of coefficient of static friction using inclined plane
7. Determination of parameters of machines (Any two)

(a) Wheel and differential axles
(b) Single purchase crab
(c) Double purchase crab
(d) System of pulleys

Mechanics of deformable body

8. Determination of hardness of metals: Brinell /Vicker/Rockwell hardness test
9. Determination of impact of metals: Izod/Charpy impact test
10. Determination of compression test on
    (a) Metals – mild steel and cast iron
    (b) Timber – along and parallel to the grains
11. Determination of tensile strength of metals
12. Determination of shear strength of metals

Design based Problems (DP): (any two)

1. For a real industrial building having roof truss arrangement, (a) take photograph & identify type of truss, (b) draw sketch of truss with all geometrical dimension, cross sections details, type of joints, type of support conditions (c) prepare a model of truss (d) identify & determine types of load acts on it (d) determine support reactions & member forces due to dead load & live load only.
2. Take a case of the Mery-Go-Round used in the fun park. Draw its sketch showing radius of wheel, no of seats, capacity of each seats and other related information. Determine the amount of resultant produced at the centre of wheel during rest position, when (i) it is fully loaded (2) it is 30% loaded with symmetric arrangement. Draw support arrangement and determine support reactions. Also determine amount of torque required to start its operation.
3. Prepare working models for various types of beams with different shape of cross section, supporting conditions and study the effect of cross section on the deflection of beams.
4. Prepare working model of simple lifting machine using different types of pulley systems and calculate various parameters like load factor, velocity ratio, law of machine, efficiency of machine etc.

Major Equipments:

1. Force table
2. Beam set up
3. Truss set up
4. Bell crank lever
5. Friction set up
6. Lifting machine
7. Hardness testing machine
8. Impact testing machine
9. Universal testing machine with shear attachment

List of Open Source Software/learning website:
www.nptel.iitm.ac.in/courses/

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will

allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

DESIGN ENGINEERING
SUBJECT CODE: 2130005

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks			Practical Marks		
L	T	P	C	ESE (E)	PA (M)		PA (V)	PA (I)	
					PA	ALA	ESE		
0	0	3	3	0	0	0	80	20	100

Design Engineering 1, 2 and 3

What is design? Design is a plan of a system, its implementation and utilization for attaining a goal. It is to change undesired situation into desired situation means to find solution for undesired/uncomfortable situation.
Designs can be for
(1) Technical systems (power plant)
(2) Educational systems (Montessori Method)
(3) Aesthetic systems (logo designs, advertisements)
(4) Legal systems
(5) Social, religious or cultural systems
(6) Theories, Models, etc.

Design thinking gives students a taste of the rich internal-remunerations associated with knowledge-creation and in curiosity and problem-driven contexts. Design need to satisfy technical functions, ergonomics functions, aesthetic functions, cost function and environment functions.

Essential features of Design:
Design solution of a problem starts with planned constructions for achieving goal/s. Designing means evolving goal oriented processes. At the beginning of the design process only goals are known while at the end, both the goals and plans are known and that to with more clarity. Goal and plans evolve together and they influencing each other. In designing process some goals are more important than others and similarly some plans are better than others. Designing does not guarantee that the design will work.

Design thinking process:
(1) Find goals or need
(2) Evaluate goals or need
(3) Generate proposals to satisfy goals
(4) Evaluate proposals
(5) Improve goals and proposals

Teaching methodology:
The design engineering should be with fun and should create excitement. It should be integrated theme across the various courses. It should promote the team work. Design is thinking and doing. The complete design process should be included in design engineering 1, 2 and 3. The prototype design must consider technical, aesthetic, ergonomics, cost and environmental requirements.

Content:

Design Engineering 1: (3 credits in Semester 3, 3 credits in Semester 4)
Introduction to product innovation process (Need-requirement-concept-detail-prototype-services-business)
Modules on: Task clarification and conceptualization: Problem-idea-solution-evaluation

- Problem identification
- Ideation
- Consolidation
- Evaluation

Project: identifying need to developing proof of concept to demonstrate solution selected

Students can tackle simple design problems with engineering content – posed by the teacher or based on a survey of real life concerns of the public. The second is more effective – the students "own the problem" - but has to be accepted by the teacher.

Examples: (a) A device to help carry heavy luggage to the upper floors of a building – a building that has no lifts. (b) Systems to ensure that water does not come out as a jet from the taps in the lower floors of a tall building. One can insist on multiple realistic solutions and all should be part of the submission along with statements of their shortcomings or advantages. Teacher should not entertain fancy solutions – based on fancy ideas - with no engineering or scientific basis.

Short lectures on the topics in the syllabus should parallel the activity.

Design Engineering 2: (3 credits in Semester 5, 3 credits in Semester 6)
Introduction to detail design
Modules on

- Design for performance, safety, reliability
- Design for ergonomics and aesthetics
- Design for manufacturability
- Design for cost, environment

Project: developing the concept into a detailed design with a functional prototype

Here one could ask students to develop products based on themes - "Garbage compactors, Energy from kitchen waste, etc" making sure that the problems identified by the students within the themes possess an engineering content and insisting on some facets of design for assembly, for manufacturability, ...and so on while preparing the design and the prototypes. One could encourage students to innovate, arrive at multiple solutions and conduct a detailed design of one of the solutions.

Prototyping requires funds and effort, so it pays to identify one subsystem of the design of the whole machine. One can insist on prototyping demonstrating at least that sub-system, if not the whole system.

Design Engineering 3: (3 credits in Semester 7, 3 credits in Semester 8)
Introduction to services and business planning
Modules on

- Design of services
- Intellectual property
- Materials and recourse planning
- Business planning

Project: developing a business model

OR

Research or Technology Development project
Modules on

- Detailed literature survey and to find out technology gap
- Intellectual property
- Re-evaluate prototype of DE-2 and proposal of novel idea

Project: developing a novel functional prototype

GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING TECHNOLOGY

FOOD ENGINEERING THERMODYNAMICS

SUBJECT CODE: 2131404

B.E. 3RD SEMESTER

Type of Course: Food Processing Technology

Prerequisite: Nil

Rationale: Knowledge of food engineering thermodynamics is required to design, operate and understand any system involving the interchange between heat and work or the conversion of material to produce heat and vice-versa. To establish the fundamentals of food engineering thermodynamics such that they can be applied to a range of processes and systems commonly encountered by food engineers. The course aims to teach the principles involved in the thermodynamic analysis of both unit operations and process equipments to provide a strong grounding required for system design and operation. It seeks to provide the necessary background so that the thermodynamic analysis of unknown systems can be approached in a logical and methodological manner. The emphasis is to make students understand the fundamentals of energy transactions in food engineering unit operations and apply these for on the field applications. Knowledge of basic mathematics and science are prerequisite for this subject. .

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Fundamental Concepts** Definitions related to Thermodynamics, Units and Dimensions	3	5
2.	**Ideal and Real Gases** Concept of ideal gas, Characteristic equation of gas. Gas laws, Universal and Characteristic gas constant. Enthalpy and Specific heat. Deviation of real gas from ideal gas, Compressibility factor and the Van der Waal's equation of state for real gas.	09	15
3	**Zeroth Laws of Thermodynamics** Zeroth Law, Concept of temperature and its measurement. Equality of temperature, calibration and calculations.	04	5
4.	**First Law of Thermodynamics** First law of thermodynamics. Concept of processes, Flow processes and control volume, Flow work, Steady flow energy equation, Mechanical work in a steady flow process, Throttling process, Application of first law to open, closed and isolated systems.	08	20
5.	**Second Law of Thermodynamics**	10	20

	Essence of second law, Thermal reservoir, Heat engines and thermal efficiency, COP of heat pump and refrigerator, Definition of available and unavailable energy, Statement of second law, Carnot cycle, Carnot theorem, Clausius inequality, Concept of entropy, Entropy change for ideal gases.		
6	**Thermodynamic Relations** Maxwell's equations, thermodynamic property relations for a pure substance, Joule-Kelvin effect, Clausius-Clapeyron equation, Gibbs phase rule, types of equilibrium, and conditions of stability.	07	15
7.	**Properties of Pure Substance (steam)** Definitions, Steam quality, P-V and T-S phase diagrams, Steam& Water Tables and its application in food engineering operations.	04	5
8.	**Psychrometrics** Psychrometric parameters and their relationships,Psychrometric properties of air.PsychrometricCharts, Mixing of air streams, Heating and cooling processes, Humidification and dehumidification processes and their applications in food processing.	07	15

Reference Books:

1. Engineering Thermodynamics by P. K. Nag (TMH)
2. Thermodynamics and Heat Engines - Vol I by Yadav, R (Central Publishing House, Allahabad)
3. Engineering Thermodynamics by Rogers, P H and Mayhew, H
4. Thermodynamics by Holman, J P (TMH)
5. An Introduction to Thermodynamics, Y.V.C. Rao, New Age International (P) Ltd., Publishers

Course Outcomes:

At the end of this course students will be able to:

1. Ability to apply the Knowledge of Fundamental concepts to Practical Food Engineering Systems such as Pumps, Compressor, Boilers, Engines, Turbines, Nozzles, Diffusers, Heat Exchanges, Condensers etc. as well as Non-Flow systems for their Thermodynamic Analysis. Determination of Thermodynamic Properties, Work Transfer, Heat Transfer, Mass/Energy /Enthalpy Balance etc.
2. Ability to apply the Knowledge of Fundamental concepts to Food equipment such as Refrigerator & Heat Pump as well as for Non-Flow System for their Thermodynamic Analysis viz:- Determination of Temperatures, Heat Transfer, Work Transfer, Refrigerating / Heating Effect, COP etc.
3. Ability to apply the Knowledge of Fundamental concepts to Food Engineering Devices as well as Non-Flow Systems for their Thermodynamic Analysis viz:-Determination of Entropy Changes, Heat /Work Transfer, Available Energy, Availability, Energy Destruction, Irreversibility, Exergy Change etc.
4. Ability to apply concepts to Food Engineering Devices with pure substance as working fluid for their Thermodynamic Analysis viz:- Determination of various Thermodynamic Properties-Pressure, Volume, *Temperature, Enthalpy, Internal energy, Entropy,* ***Dryness Fraction, Work / Heat Transfe*****r, Mass/Enthalpy/Energy Balance etc. using** Steam Tables and Mollier Chart.
5. Ability to apply the Knowledge of Fundamental concepts to Practical Engineering Devices such as Compressors, Gas Turbines, Nozzles, Diffusers, Heat Exchangers as well as Non-Flow

Systems with Ideal Gas or Mixture of Ideal Gases as working fluid for their Thermodynamic Analysis.

6. To enable students to carry out Psychrometric calculations and use Charts for their applications in food processing.
7. Develop Thermodynamic Relationships for practical food processing applications.

List of Open Source Software/learning website

- http://nptel.ac.in/courses/112103016/
- http://imechanica.org/node/9501
- http://ocw.nd.edu/aerospace-and-mechanical-engineering/thermodynamics
- http://tigger.uic.edu/~mansoori/Thermodynamics.Educational.Sites_html
- http://units.handbooks.uwa.edu.au/units/mech/mech4429
- http://www.saylor.org/courses/me103

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GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING TECHNOLOGY

INTRODUCTION TO FOOD PROCESSING TECHNOLOGY

SUBJECT CODE: 2131405

B.E. 3RD SEMESTER

Type of Course: Food Processing Technology

Prerequisite: Nil

Rationale: The main objective of introducing this subject in the degree course of food processing technology is to expose the student with fundamental knowledge on movement of liquid foods, fundamentals of heat transfer, status of food industries in India, preservation techniques and value added operations. The students would be exposed to various aspects of fundamentals of food processing.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	0	4	70	20	10	0	0	0	100

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage (%)
1.	**Engineering units and Dimensions** Base units, Derived units and Supplementary units	04	8
2.	**Present status of food Industry In India** Prospects for future growth in India and Abroad	04	8
3	**Food as a source of nutrients** Function of Food-Physiological, Social, Psychological and specific. Recommended daily allowances for nutrients.	05	8
4.	**Classifications and composition of foods** Plant Foods - Cereals and Millets, Legumes and Pulses, Vegetables, Fruits, Nuts & Oil Seeds, Condiments & Spices. Animal Foods - Eggs, Milk and its products, Meat and Meat Products, Poultry Sea foods. Soft drinks. Semi Processed and Ready to Eat Foods.	06	15
5.	**Steam Tables, Psychometric Chart** Basic methods and applications	04	8
6.	**Fundamentals of Mass and Energy balance** Application of mass and energy balances in food engineering operations	06	15
7.	**Units Operations** Equipment and Machinery deployed in food processing Industry, Cleaning, Grading, Peeling, Cutting Balancing, Pulping, Size reduction, Separation	05	12

8.	**Drying and Evaporation** Moisture content, Moisture diffusion, Water Activity, Types of dryer	05	11
9	**Food Deterioration, Preservation and Processing** Basic concepts, factors affecting the food deterioration and different preservation techniques	02	05
10	**Food Product Development and Design** Quality control, Food Evaluation Methods.	03	05
11	**Marketing of Foods and Food Products** Statutory laws and requirements of Foods	03	05

Reference Books:

1. Food Preservation and Processing, Manoranjan Kalia & Sangita Sood.
2. Food Science, N. N. Potter, C B S Publishers & Distributors.
3. Food Facts & Principles, N. Shankuntala M.& M. Shadakshara S., Wiley EasternLimited.
4. Unit Operations, K. M. Sahay and K. K. Singh.
5. Engineering of Dairy & Food Products, A. W. Farral

Course Outcomes:

At the end of this course students will be able to:

1. Describe the principals involved in the processing of the major types of food products
2. Understand the principles of food spoilage and the ways to prevent
3. Describe the function of food additives in food processing
4. Recognize the major food borne pathogens and means to control or prevent their growth in foods

List of Open Source Software/learning website

- http://foodscience.uark.edu/
- http://www.ucc.ie/en/ace-dfsct/
- http://www.sciencedirect.com/science/book/
- http://ciftinnovation.org/food-processing

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING TECHNOLOGY

FOOD CHEMISTRY

SUBJECT CODE: 2131407

B.E. 3RD SEMESTER

Type of Course: Food Processing Technology

Prerequisite: Nil

Rationale: Food chemistry is one of the major aspects of food science which deals with the composition and properties of food and the chemical changes it undergoes during handling, processing, and storage. The course will cover topics like Water, Carbohydrates, Protein, Lipids, Minerals, Pigments and Food Additives. This course provides students with knowledge on the chemical constituents of food and their functional significance in food systems; it will also be beneficial to evaluate how the conditions of storage and handling of food substances affect food qualities .

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage (%)
1.	**Moisture in foods** Structure, Properties, Types of water in food and their specific function, Water activity and stability.	6	15
2.	**Lipids** Classification, Structures, Physical and chemical properties, Rancidity and its types.	8	15
3	**Carbohydrates** Definition, Classification, Functions, Properties of simple and complex carbohydrates.	8	15
4.	**Proteins** Introduction, Classification and structures, Physicochemical properties, Nutritive and supplementary value of food proteins, Denaturation and its implications, Gel formation and its theories.	10	20
5.	**Pigments** Introduction and significance of natural pigments in food - Chlorophylls, Carotenoids, Haemoglobin and Myoglobin, Anthocyanins, Flavonoids, Betalains Tannins.	06	15
6.	**Food additives** Definitions, uses and functions of: Acids, Bases, Buffer system,	08	20

	Chelating / sequestering agents, Low calorie and non-nutritive sweeteners, Antioxidants, Emulsifying and Stabilizing agents, Anti-caking agents, Thickeners, Firming agents. Flour bleaching agents and Bread improvers. Anti-microbial agents/class-I and Class –II preservatives		

Reference Books:

1. Food Chemistry by L H Meyor (CBS Publisher, Delhi)
2. Food Facts and Principal by N. ShakuntalaManay& M. Shadaksharaswamy (New International (P) Ltd. Publishers, New Delhi)
3. Food Chemistry by O.R. Fennema, 2nd edn. (Marcel Dekkar Inc.)
4. Food Chemistry by H D Belitz and W. Groech (Springer Publ.)
5. Food Additives by S.N. Mahindru
6. Food Processing and Preservation by B.Siavsankar (Prentice Hall India)

Course Outcomes:

At the end of this course students will be able to:

1. Name and describe the general chemical structures of the major components of foods (water, proteins, carbohydrates, and lipids) and selected minor components (e.g. minerals pigments and additives).
2. Know the functional behavior of these food components with respect to food quality, nutrition and safety.
3. Predict how processing conditions are likely to change the reactivity of food components.
4. Control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications.
5. Describe the physicochemical properties of water and the significance of water activity to the stability of foods.
6. Describe the chemistry of carbohydrates and the mechanisms of non-enzymatic and enzymatic browning.
7. Understand the chemistry and significance of lipids in foods.

List of Practical:

1. Introduction to laboratory instruments and equipments
2. Determination of moisture content in food by hot air oven method.
3. Determination of acidity of given food sample
4. Determination of moisture content in food sample by Infra Red Moisture Balance/Meter
5. Determination of specific gravity of given oil sample
6. Determination of ash content in given food sample
7. Determination of crude fat by Soxhlet method
8. Determination of acid value of given oil sample.
9. Determination of Saponification value of given oil sample.
10. Determination of protein content by Micro-Kjeldhal method

Open Ended Problem:

- Effect of temperature on gelation of various food proteins.
- Factors affecting on chlorophyll retention in green leafy vegetables.

List of Open Source Software/learning website

- www.ift.org/knowledge-center/core-sciences/food-chemistry.aspx
- www.rsc.org/foodfunction
- www.wiziq.com/tutorials/food-chemistry
- www.fao.org/food/food-safety-quality/scientific-advice/jecfa/en/

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GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING TECHNOLOGY

BASIC FOOD MICROBIOLOGY

SUBJECT CODE: 2131407

B.E. 3RD SEMESTER

Type of Course: Food Processing Technology

Prerequisite: Nil

Rationale: Food microbiology is the study of the microorganisms that inhabit, create, or contaminate food. It includes the study of microorganisms causing food spoilage and "Good" bacteria, such as probiotics. In addition, microorganisms are essential for the production of foods such as cheese, yogurt, other fermented foods, bread, beer and wine. Another indispensable aspect of food microbiology is food safety which entails testing of foods for permissible count and type of microorganisms and presence of pathogens (disease or infection causing microorganisms) .

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage (%)
1.	**Introduction to Microbiology** The scope and history of microbiology.	4	10
2.	**Morphology and Fine Structure** External and Internal structures ofBacteria, (membrane and major organelles, Appendages, Spores). Morphology and Characteristics of Fungiand Algae	5	10
3	**Identification of Microbes** Characterization and Identification of microorganisms (Biochemical and staining methods). Principles and types of different microscopes.	5	10
4.	**Microbial Growth** Bacterial Growth phases, auxotroph, bradytroph, Replica plating, Microbial Reproduction and preservation of microorganisms.	4	10
5.	**Introduction to microbial genetics** Microbial genome and plasmids, detection of microorganisms using molecular, serological and proteomic techniques (SDS-PAGE, Blotting techniques, hybridization, PCR, ELISA).	07	20
6.	**Modification of Microbial Genome** Genotype changes (acquisition of resistance markers), Bacterial	05	10

	recombination, conjugation, transformation and transduction.		
7.	**Significance of Microorganisms in Foods** Primary sources of microbesinfood, Role of intrinsic and extrinsic parameters that effect microbial growthin foods.	05	10
8.	**Fermented Foods** Starter organism, Probiotics, Prebiotics, Synbiotics, functional foods, Fermented foods (dairy, traditional, meats).	05	10
9	**Control of Microorganisms** Control of microorganisms by Physical andChemical agents.	05	10

Reference Books:

1. General Microbiology by Roger Y. Stanier, John L. Ingram, Mark L. WheelsandPage R. Painter. (Macmillan Press Ltd.)
2. Microbiology by M. J. Pelczar Jr., E.C.S Chan and Noel R Krieg. Tata McGraw-Hill
3. Food Microbiology, W C Frazier and D C Westhoff, McGraw Hill Book Company,NY

Course Outcomes:

At the end of this course students will be able to:

1. Identify the microorganisms based on their structural and growth characteristics
2. Identify and quantify the microorganisms using rapid techniques (molecular, immunological, proteomic)
3. Develop concept of genetic transfer mechanisms leading to multidrug resistance
4. Understand and characterize the natural microflora, starter, probiotic and pathogenic
5. Understand the methods to control microorganisms

List of Practical:

An introduction to microorganisms and bio-safety levels and lab equipments

a. Staining techniques
   - Simple staining
   - Negative staining
   - Gram staining
   - Acid fast staining
   - Endospore staining
   - Capsule staining

b. To determine motility of the given culture
   - Visualization of fungi
   - Preparation & sterilization of culture medium
   - Bacteriological examination of water sample by estimating Most Probable number of coliforms per 100 ml of sample (MPN TEST)
   - To determine antibiotic susceptibility of given microbial culture using disk diffusion method (Kirby-Bauer method)
   - To study the microbial growth curve
   - To study the effect of various factors on microbial growth

- Identification of enteric bacteria using biochemical tests (IMViC)
- To perform viable plate count by spread plate or pour plate method
- To study carbohydrate fermentation using Triple Sugar Iron Agar

Open Ended Problem:

The topics taught in this subject would be useful to develop insight and application based knowledge among students

Determine a substance which is antimicrobial, heat stable, small molecular peptide, produced during exponential phase. Try to develop assays to prove each characteristic. Which microorganisms produce this substance? What is the name of the substance and enlist the applications in food preservation? Prepare a product containing this substance and compare its shelf life with control sample.

Major Equipments:

1. Laminar air flow cabinet
2. Autoclave
3. Microscope
4. Colony counter
5. Biological /BOD incubator
6. Refrigerator

List of Open Source Software/learning website

- http://highered.mcgraw-hill.com/sites/0072556781/student_view0/chapter13/animation_quiz_1.html
- http://highered.mcgraw-hill.com/sites/0072943696/student_view0/chapter3/animation.html
- http://users.ugent.be/~avierstr/principles/pcrani.html
- http://aggie-horticulture.tamu.edu/food-technology/food-processing-entrepreneurs/microbiology-of-food/

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