CURRICULUM
for

THREE YEARS DIPLOMA PROGRAM

IN

FOOD/DAIRY TECHNOLOGY
(Proficiency Certificate Level)

Council for Technical Education and Vocational Training (CTEVT)

Curriculum Development Division

Sanothimi, Bhaktapur

November, 2001

(Revised)

Table of Contents

1. Aims and Objectives:

The aims and objectives of the program are to produce middle-level manpower needed by food and dairy industries in Nepal. After completing the course, students will be able to contribute both in production and quality control. The will also be able to set up small-scale industries.

2. Program description:

The course involves theory, practical and demonstration for teaching. The medium of teaching, for the most part, will be English. The students will get knowledge and skill in all possible subjects related to food and dairy industries. The program includes *On-the-Job Training* and *Proposal Writing* during the sixth semester, which can be very instrumental in helping the students develop analytical skill and confidence.

The program is intended for SLC-pass students aspiring for technical education. Both male and female, and of all nationalities, can join the program.

3. Program structure:

3.1. Program Structure for Dairy Technology

SEMESTER	S.N.	Subjects	Hours/Period distribution		Marks distribution & Time for Exam							
			Hours/week	Hours/semester	Theory				Practical			Subject Total
					Assessment	Final (Ext.)	Total	Time for Exam	Assessment (Int.)	Final (Ext.)	Total	
			Th +Pr=Total	Th +Pr=Total								
FIRST SEMESTER		***Common:***										
	1	English – I	8 + 0 = 8	156+0=156	20	80	100	3 hrs	--	--	--	100
	2	Mathematics	8 + 0 = 8	156+0=156	20	80	100	3 hrs	--	--	--	100
	3	Physics – I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	4	Chemistry – I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	5	Biology - I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	34+6=40	663+117=780	85	340	425	-	15	60	75	**500**
SECOND SEMESTER		***Common:***										
	1	English – II	8 + 0 = 8	156+0=156	20	80	100	3 hrs	--	--	--	100
	2	Nepali	8 + 0 = 8	156+0=156	20	80	100	3 hrs	--	--	--	100
	3	Physics – II	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	4	Chemistry – II	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	5	Biology - II	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	34+6=40	663+117=780	85	340	425	--	15	60	75	**500**
THIRD SEMESTER		***Common:***										
	1	Basic Principles of Engineering	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	2	Principles of Food Preservation	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	3	Milk and Milk products	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	4	Basic and Food Microbiology	4 + 2 =6	78+39=117	10	40	50	2 hrs	5	20	25	75
	5	Statistics and Mathematics	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	6	Fermentation Technology	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
		Semester Total:	28+12=40	546+234=780	70	280	350	--	30	120	150	**500**
FOURTH SEMESTER		***Common:***										
	1	Biochemistry and Human Nutrition	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	2	Computer Application	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	3	Principles of Milk Processing	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
		Technology specific (Food):										
	4	Dairy Chemistry	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	5	Dairy Microbiology	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	6	Dairy Engineering	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	28+12=40	546+234=780	70	280	350	--	30	120	150	**500**
FIFTH SEMESTER		***Common:***										
	1	Quality Control and Total Quality Management	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	2	Storage and Packaging	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
		Technology specific (Food):										
	3	Technology of Dairy Products – I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	4	Technology of Dairy Products – II	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	5	Technology of Dairy Products – III	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	6	Technology of Dairy Products – IV	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	28+12=40	546+234=780	70	280	350	--	30	120	150	**500**
SIXTH SEMESTER		***Common:***										
	1	Food Analysis	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	2	Project writing	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	3	On-the-Job Training (**OJT**)	0 + 24 = 24	0+468=468	--	--	--	--	--	--	300	300
		Semester Total:	12+28=40	234+456=780	30	120	150	--	10	40	**350**	**500**
		GRAND TOTAL:		**3198+1482=4680**			**2050**				**950**	**3000**

3.2. Program Structure for Food Technology

SEMESTER	S. N.	Subjects	Hours/Period distribution		Marks distribution & Time for Exam							
			Hours/week	Hours/semester	Theory				Practical			Subject Total
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	2	Mathematics	8 + 0 = 8	156+0=156	20	80	100	3 hrs	--	--	--	100
	3	Physics – I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	4	Chemistry – I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	5	Biology - I	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	34+6=40	663+117=780	85	340	425	-	15	60	75	**500**
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	1	English – II	8 + 0 = 8	156+0=156	20	80	100	3 hrs	--	--	--	100
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	3	Physics – II	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	4	Chemistry – II	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
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	1	Basic Principles of Engineering	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
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	5	Statistics and Mathematics	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
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	3	Principles of Milk Processing	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
		Technology specific (Food):										
	4	Food Chemistry	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	5	Technology of Food Products (TFP) – I	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	6	Food Engineering	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	28+12=40	546+234=780	70	280	350	--	30	120	150	**500**
FIFTH SEMESTER		***Common:***										
	1	Quality Control and Total Quality Management	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	2	Storage and Packaging	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
		Technology specific (Food):										
	3	Technology of Food Products – II	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	4	Technology of Food Products – III	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	5	Technology of Food Products – IV	4 + 2 = 6	78+39=117	10	40	50	2 hrs	5	20	25	75
	6	Elective (any one): *Fat & Oil Technology* ***or*** *Sugar Technology*	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
		Semester Total:	28+12=40	546+234=780	70	280	350	--	30	120	150	**500**
SIXTH SEMESTER		***Common:***										
	1	Food Analysis	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
	2	Project writing	6 + 2 = 8	117+39=156	15	60	75	2.5 hrs	5	20	25	100
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		Semester Total:	12+28=40	234+456=780	30	120	150	--	10	40	**350**	**500**
		GRAND TOTAL:		**3198+1482=4680**			**2050**				**950**	**3000**

4.Target Group:

This program is intended for SLC pass students aspiring for technical education. Both male and female, and of all nationalities, can join the program. .

5. Group size:

This institute has a capacity of 40 students per semester. For greater effectiveness, only 10 students will be taken for each practical. For theory classes, spacious classrooms are available, capable of accommodating 10 to 60 students.

6. Duration:

The program consists of six semesters (= 3years).

7. Pattern of attendance:

The students are required to have a minimum of 90% attendance. Those failing to achieve this will be disqualified for the final exams.

8. Approach:

Semester system

9. Entry criteria:

The candidates should be SLC-pass. In general, the candidates must be Nepali citizen and have a minimum of 50% score in the SLC. For those from very remote areas (also for girls) 45% score in the SLC is considerable. The final selection for eligibility entails entrance exam conducted by CTEVT.

10. SUBJECTS

10.1. FIRST SEMESTER (Common subjects for both Food and Dairy Technology)

10.1.1. English – I
10.1.2. Mathematics
10.1.3. Physics – I
10.1.4. Chemistry – I
10.1.5. Biology - I

10.1.1. Subject: English-I

Description:

Upon completion of this course the students will be able to use English both for academic and communicative purpose. The course will also serve as a bridge between secondary and University English. This is an integrated general English course, which treats English as a medium for communication and as a means to knowledge. This course is divided in to interrelated papers leading students from intermediate level of English proficiency to upper intermediate.

Contents:

1 A remedial or refresher course:

It will be given at the beginning of the session. The contents include basic English structures and the use of dictionary

2 Core English:

The text in this component primarily aims at teaching various language skills in an integrated manner. The emphasis is on providing tools for using language for communicative purposes, and for receiving as well as imparting information effectively. The contents of this unit are:

(a) places (b) decisions and intentions (c) jobs and routine (d) direction (e) past event (6) talking about now (7) requests and offers (8) recent actions and activities (f) comparison (g) the past and present (h) likes and dislikes (i) events and circumstances (j) leisure activities and skills (k) advice

3 Extensive reading and writing:

The prescribed materials in this component expose students to various interesting and informative topics of global interest and common human concern. The contents include:

a) Poems:

i) Mark Strand, "Keeping Things Whole"

ii) Cowper, "The poplar field"

iii) W.Wordsworth, "My Heart Leaps Up When I Behold"

b) Essays:

i) Barbara Holland, "Speaking of Children"

ii) Joan Didion, "In Bed"

iii) Issac Asimov, "The Nightmare Life Without Fuel"

c) Stories:

i) Stories of the supernatural: "The Recurring Dream", "The Lost Doll", "The house call", "Fear", "The Loving Mother"

ii) R. Kipling, "The Gardener"

d) Play:

i) 17. R.N. Tagore, "Malini"

Practical skills:

- Write essays
- Write short stories
- Write critical appreciation

Books:

1. Doff, Adrian, C. Jones, and K. Mitchell. Students' Book. Cambridge: Cambridge University Press. 1983.
2. Link English. Revised edition. Kathmandu: Sajha Prakashan, 1996.
3. Meaning in to words (Intermediate). Workbook. Cambridge: C.U.P. 1983.
4. The Magic of Words (A collection of poetry, prose and drama) Kathmandu, 1996.

10.1.2. Subject: Mathematics

Description:

This course enables the students to create aptitude for mathematics and understand its principles. The students will be able to apply mathematics in the chosen field.

Contents:

A. Set Theory and Real Number System

1. Set Theory: Review of Sets, notations, types of sets, Venn-diagram, Set operations, Laws of algebra of sets, Cardinality of a finite set and related problems, Cartesian product, Relation, Domain and Range of Relation, Inverse Relation.
2. Real Number System: Types of Numbers, Real number line, Absolute values, Intervals and Inequalities.

B. Functions and Graphs

1. Review of Functions, their notions, Domain and Range and types of functions.
2. Inverse function, composite function and related problems.
3. Introduction to other functions, viz. Algebraic functions.
4. Trigonometric functions and their graphs.
5. Logarithmic functions.
6. Hyperbolic functions.

C. Matrices and Determinants

1. Matrices, types of matrices, Algebra of matrices, Minors and Cofactors, Adjoint and inverse of a matrix, Determinant of square matrices (up to s3x3)

D. Systems of linear Equation and Inequalities

1. System of linear equation: Linear Equations, Solutions of system of linear equations by row equivalent method, inverse matrix method and Cramer's rule.
2. System of linear inequalities: Simple Linear Inequalities and their Graphs,
3. System of Linear Inequalities in two variables, Maximization and Minimization in two variables cases under given linear constrains.

E. Polynomial Equation

1. Review of Polynomial Equation, Factor and Remainder theorem
2. Fundamental theorem of Algebra (without proof).
3. Quadratic Equation, Natures of roots of quadratic equation, Relation between roots and coefficients of quadratic equation, Formation of quadratic equation.

F. Simple partial fraction

1. Rational fraction, Problems related to different cases for partial fractions:

2. Denominator containing

   i. distinct linear factors

   ii. repeated linear factors and

   iii. linear and distinct quadratic factors

G. Sequence and Series

1. The Progression, A.P, G.P, and H.P., A.M., G.M, H.M., general terms, Sum of squares and cubes of natural numbers, Sum of infinite geometric series.

H. Permutation, Combination and Binomial Theorem

1. Basic principles of counting, Permutation of a set of objects, Combination and related problems.
2. Binomial Theorem for positive integral index, General and Particular application Binomial theorem

I. Trigonometric Function and Their Inverses

1. Inverse Trigonometric Functions, their graphs, Formulae involving inverse circular functions, Simple Identities and equation involving inverse circular function.
2. Review of trigonometric function, Basic formulae and their uses, Identities and conditional identities
3. Simple Trigonometric Equations, General values, their uses in solving trigonometric equations..

J. Properties of Triangle

1. The sine law, The cosine law, The projection law, the half angle formulae, the area of triangle, the in-circle and ex-circle of a triangle.

K. Straight Lines

1. Review of co-ordinates, basic formulae, locus and its equation, Various forms of equation of straight lines, intersection of two lines any line through the intersection of two lines, parallelism and perpendicularity, distance of a point from a line, orthocentre, circumcentre, incentre and centroid of a triangle, angle between two lines.

L. Pair of Lines and Circles

1. Equation of second degree, homogeneous and non-homogeneous, Condition for general second degree equation to represent a pair of lines, angle between pairs of lines, Bisectors of the angle between pairs of lines, Identification of bisectors.
2. Definition of circle, equations of circle and related problems, Definition of parabola and ellipse

M. Limits and Continuity

1. Notion of Limits, Fundamental theorem (without proof), Limits of simple algebraic and trigonometric functions, Continuity of a function at a point, Test of continuity.

N. Derivatives

1. Derivatives from definition of simple function like x^n, $(ax+b)^n$, sin(ax+b), Cos(ax+b),e^x, a^x, logx etc. Derivatives of sum, difference, product and quotient of function, chain rule, parametric function, Implicit function, Derivatives of trigonometric function, Derivatives of natural logarithmic and exponential functions.

O. Antiderivatives

1. Rules of finding integrals, fundamental integral and their uses; antiderivatives by substitution method, integration by substitution method, indefinite and definite integrals

P. Vectors

1. Definition, notation, representation, modulus, types of vectors, vector addition, Subtraction, multiplication of a vector by scalar, unit vector, product of two vectors, dot product, Condition of perpendicularity, angle between vectors, Properties of scalar product, expression for Cosθ, Properties of vector product, Simple geometric application of vectors

Practical skills:

Books:

1. Basic Mathematics Vol. II –B.C. Bajracharya and R.M. Shrestha
2. Senior Secondary Mathematics I – G.D. Pant
3. Elements of Mathematics I – Nir Kumar Chettri and B. Bhattarai
4. Senior Secondary School Mathematics XI -
5. Certificate Mathematics – G.D. Pant

10.1.3. Subject: Physics-I

Description:

Upon completion of the course the students will be able to utilize physical principles in their chosen field. They will be also be able to carry out various practical works related to physics

Contents:

A. Mechanics and Hydrostatics

1 Measurement of physical quantities, system of units, dimensional analysis, mass, weight, use of balance, SI units
2 Speed, velocity and acceleration, equation of motion, scalars and vectors, addition, subtraction and resolution of vectors, projectile motion, Relative motion
3 Newton's laws of motion, Circular motion, Kepler's laws of planetory motion,
4 Simple harmonic motion, simple pendulum
5 Force, Friction and its laws, Gravity and gravitational, work, energy and power
6 Rotational motion of rigid bodies, moment of inertia, torque, angular momentum and its conservation
7 Elasticity: Hook'es law, Young's shear and bulk moduli: stress and strain
8 Simple machine, lever and balance
9 Viscosity and surface tension
10 Archimedes' Principle, floatation, balloons and ships
11 Pressure: variation in atmospheric pressure and its measurement, Barometer,
12 Fluids in motion: Bernoulli's Principles, velocity coefficient, stokes law
13 Specific gravity and density relative density: determination of specific gravity, Nicholson hydrometer, common hydrometer, pyknometer

B. Heat

1 Thermometer: temperature scales, types of thermometers, fixed points and their determination, choice of liquid for thermometric substance, thermocouple, principle of resistance, thermometer
2 Expansion of solids, Linear, Superficial and Volume coefficients and their relations
3 Expansion of liquid, dilatometer, wet thermometer
4 Heat capacity, Specific heat capacity
5 Simple treatment of gas properties on the basis of kinetic theory of gases
6 Calorimetry, Latent heat
7 Transmission of heat: conduction, convection, radiation, pyrometer
8 Change of state: melting, boiling and freezing point, saturated and unsaturated vapors, evaporation and condensation
9 Hygrometry, humidity control, formation of fog, dew, hailstone etc.
10 Thermodynamics; first and second law: Carnot's cycle and heat engines
11 Radiation, black body radiation, Stefan-Boltzman law

Practical skills:

- Use Vernier caliper/Screw gauge/Spherometer
- Determine coefficient of friction, coefficient of viscosity of water
- Verify Hooke's rule
- Verify principle of moments

- Determine specific gravity
- Determine fixed points/specific heat/latent heat
- Experiment with simple pendulum
- Use of Nicholson's hydrometer to calculate sp.gr.

Books:

1 A Textbook of Physics, part 1 and 2 – J.M. Pradhan
2 Principles of Physics- Brijlal and Subramanyam
3 Advance Level Physics (5th edition) Nelkon and Parker
4 Numerical Examples in Physics, part 1 and 2, V.K. Shrestha
5 Certificate Level Physics Practical Guide- U.P. Shrestha
6 College physics-F.W. Sears, S.W. Zemanskyi and Young

10.1.4. Subject: Chemistry-I

Description:

Upon completion of the course the students will be familiar with chemical world of matter. They will be able to prepare standard chemical and carry out chemical analysis related to food and dairy technology. The course will also be helpful in understanding biochemistry, nutrition, and food and dairy chemistry.

Contents:

A. Fundamentals

1 Significant figures, units of measurement of length, mass, temperature and pressure, analysis of units, graphs plotting, relation between mass, weight and volume
2 Three states of matter, elements, compounds and mixtures, symbol, formula, atoms and molecules (definitions with examples only)
3 The law of chemical combinations: the law of definite proportion and the law of constant composition, law of conservation of mass, the laws of reciprocal and multiple proportions (with numericals)
4 Gas laws, Boyle's law, Charle's law, absolute zero, Kelvin scale, universal gas constant, Dalton's law of partial pressure, Graham's law of diffusion
5 Properties of liquid, types of solutions (saturated/unsaturated/supersaturated), concentrated and dilute solutions, solubility, solubility curve, vapor pressure, viscosity

B. Chemical structures

1 Atomic structure, Rutherford and Bohr atomic models, atomic number, atomic weight (definition with examples, determination by Dulong and Pettit's method), isotopes and isobars, subatomic particles (electron, proton and neutron),
2 General study of periodic table (Group, Period, sub-group), Mendeleev's and modern periodic law, Mendeleev's and modern periodic table (introduction), representative elements, transition elements, noble gases, lanthanides and actinides, *s, p, d, f* blocks (introduction), periodic properties (atomic radius, IP, electronegativity, valency and metallic character)
3 Valency: three kinds of chemical bonds, electronic theory of valency (basic assumptions), Lewi's structure (some important molecules), properties of electrovalent, covalent and coordinate covalent compounds) octet rule
4 Molecular weight, definition with example, determination by Victor Meyer's method, calculation
5 Avogadro's hypothesis and its application

C. Chemical reaction

1 Chemical equation and the method of balancing them (heat and trial method, partial method and oxidation-reduction method)
2 Chemical reactions: addition reaction, decomposition reaction, double decomposition reaction, oxidation-reduction reaction, neutralization, hydrolysis, polymerization and rerrangement.
3 General concept of strong acid and weak acids, strong and weak bases and different types of salts. The pH concept of solution
4 Oxidation number, its calculation, oxidizing and reducing agent

D. Chemistry of water

1. Molecular structure of water, hydrogen bonding, water as universal solvent

2. Physical and chemical properties of water: temporary and permanent hardness, method of removal of hardness of water, temporary (by heating and treatment with CaO, permanent (addition of Na_2CO_3, permutit process)

E. Non-metals and Metals

1. Hydrogen (general method of preparation), Oxygen (lab preparation by using heat and without using heat), Nitric acid (manufacture by ostwald process, reaction with metals, reaction as acid and oxidizing agent), Halogens (chlorine, lab preparation and general reaction), Sulfuric acid (manufacture by contact process, reaction as acid and oxidizing agent, reaction with $BaCl_2$)
2. Metals and their alloys: occurrence, general extraction,
3. Alkali and alkaline earth metals (Na, manufacture by Down's process), chemistry of Na_2CO_3, NaOH, plaster of Paris.
4. Study of coinage metals (Cu), occurrence, extraction, properties and uses, compounds (copper sulfate hydrated, preparation,properties and uses)

Practical skills

- Keep records in practical book
- Identify simple apparatus in the lab
- Carry out simple first aid operations
- Operate/ study Bunsen burner
- Fit different apparatus
- Carry out separation activities: filtration/sublimation/distillation/crystallization
- Handle chemical balance
- Carry out precipitation reaction: barium chloride with copper sulfate, silver nitrate with HCl
- Carry out acid-base reaction: calcium carbonate and hydrochloric acid
- Prepare standard solutions (normal, semi normal, deci normal)
- Analyze different salts

Books:

1. Modern Practical chemistry – Y. R. Sharma
2. Elementary Quantitative Analysis – M.K. Sthapit
3. Textbook of Inorganic Chemistry – L.M. Mitra
4. Intermediate Organic Chemistry – B.S. Bahal

10.1.5. Subject: Biology-I

Description:

The course provides the students with basic concepts of biology and encourages them to use the knowledge of daily life. The students will also be able to use the biological principles fruitfully in the chosen field.

Contents:

Group-B (Zoology)

1 Brief Survey of Animal Kingdom
   a) General account and classification of vertebrates and invertebrates
   b) Life cycle of earthworm
2 Biota and environment
   a) Ecology: concept of ecosystem:
   b) Abiotic (light, moisture, wind, gas, biogenic salts) and biotic factors and their interaction
   c) Virus: concept of virus, types of virus, economic importance of virus
   d) Trophic levels, food chain, food web and ecological pyramid
   e) Pond ecosystem: structural and functional aspect
   f) Grassland ecosystem: structural and functional aspect
   g) Biogeochemical cycle: carbon and nitrogen
   h) Ecological balance and its consequences
   i) Green house effect
   j) Depletion of ozone layer
   k) Acid rain
3 Animal adaptations: aquatic, amphibian, terrestrial (arboreal and volant)

Group-A (Botany)

1 Introduction:
   a) Nature and scope of biology
   b) Branches and relation with other sciences
2 Cell biology:
   a) Structure of prokaryotic and eukaryotic cells, cell organization and their functions
   b) Biochemically important molecules (general concept)
   c) Cell division: mitosis, meiosis
3 Biodiversity:
   a) Concept of taxonomy: classification, binomial nomenclature
   b) Five kingdom classification:
      i) Monera- Nostoc;
      ii) Protista- Paramecium;
      iii) Plantae:
         - Algae-Spirogyra
         - Bryophyta- Marchentia;
         - Pteridophyta- Fern;
         - Gymnosperm- Pinus;
         - Angiosperm- Maize/sunflower;
      iv) Mycota- Mucor/Mushroom
      v) Animalia- see **group B**

Practical skills:

- Carry out study of lay out/setting of biology laboratory
- Handle/maintain microscope
- Carry out preparation of onion cell
- Carry out study of museum specimen (zoology + botany)
- Preserve/maintain herbarium/animals
- Carry out study of pond ecosystem
- Prepare slides of biological samples
- Identify/describe/study various parts of spirogyra/ Mucor/ marchentia/ fern/ pinus/ maize/ sunflower
- Demonstrate different stages of mitosis cell division from permanent slide
- Carry out general anatomy of earthworm/digestive system of earthworm

Books:

1 A textbook of biology (part I and II) – S. Agrawal
2 Modern approach botany - Bhatia
3 A textbook of practical zoology –
4 Handbook of botany practical – H.D. Ranjitkar

10.2. SECOND SEMESTER (Common subjects for both Food and Dairy Technology)

10.2.1. English – II
10.2.2. Nepali
10.2.3. Physics – II
10.2.4. Chemistry – II
10.2.5. Biology - II

10.2.1. Subject: English-II

Description;

This course is a continuation of first semester. It builds on to the language skills and communicative competence introduced in the previous semester
The main objectives of this course are:
To teach students language use and functions
To provide them with more examples of language in context, and structures in a context.
To enable the students to use English for academic and communicative purpose
To engage them in more fruitful reading

Course contents:

1 Core English

a) Similarities and differences
b) Obligation
c) Prediction objects
d) Degree
e) Setting a scene
f) Criticizing
g) Explanations

2 Intensive reading and writing:

a) Poems:

i) William Stafford, "Traveling through the Dark"
ii) W.B. Yeats, "The lamentation of the old pensioner"
iii) Ray Young Bear, "Grandmother"

b) Essays:

i) Moti Nissani, "Two long term problems"
ii) Martin Luther King, "I Have a dream"
iii) Marsha Traugot, "The Children Who Wait"

c) Stories:

i) Pal, "The Tell-Tale Heart"
ii) James Joyced, "The Boarding House"

d) Play:

i) W.B. Yeats, "Purgatory"

Practical skills:

- Write essays
- Write short stories
- Write critical appreciation

Books:

1. The Heritage of Words - Lohani, Adhikari & Subedi
2. Meanings in to words (intermediate), Student's Book – Doff, Achian, Christopher Jones, Kith Mitchell
3. Meanings in to words (workbook) – Doff, Achian, Christopher Jones, Kith Mitchell

10.2.2. विषय: नेपाली (Nepali)

खण्ड (क) नेपाली व्याकरण

एकाइ (अ) नेपाली वर्ण र वर्णविन्यास

(क) नेपाली वर्णहरुको परिचय
- (१) स्वरवर्ण: परिचय र वर्गीकरण
- (२) व्यञ्जनवर्ण: परिचय र वर्गीकरण

(ख) नेपाली अक्षरहरुको संरचना

(ग) नेपाली वर्णविन्यास
- (१) कथ्य र लेख्य नेपाली भाषा
- (२) ह्रस्व–दीर्घसम्बन्धी नियमहरु र अभ्यास
- (३) श/ष/स, ब/व/ओ/ए/य/छे/क्ष/ग्यँ/ज्ञको प्रयोग
- (४) अजन्त र हलन्तवर्णहरु
- (५) पदयोग र पदवियोग
- (६) लेख्य चिन्हहरुको प्रयोग र अभ्यास

एकाइ (आ) शब्दवर्ग, शब्दरुपायन र शब्दनिर्माण

(क) शब्दवर्ग
- (१) शब्दहरुको पहिचान र वर्गीकरण (स्रोत, बनोट र कार्यका आधारमा)
- (२) नाम, सर्वनाम, विशेषण र अव्यय (नामयोगी, क्रियायोगी, निपात, विस्मयादिवोधक, संयोजक) आदिको परिचय र वर्गीकरण

(ख) शब्दरुपायन
- (१) नाम, सर्वनाम, विशेषणको रुपायन (लिङ्ग, वचन र आदरका आधारमा)
- (२) क्रियापदको रुपायन (लिङ्ग, वचन, पुरुष, काल, पक्ष, भाव, वाच्यादिका आधारमा)

(ग) शब्दनिर्माण
- (१) व्युत्पादन र रुपायन
- (२) उपसर्गहरुद्वारा शब्दनिर्माण
  - उपसर्ग र आधारतत्व
  - अ, अन, कु, बे, वि, वद, प्र,अप, सम्, अनु, अधि, अति, उत्, प्रति, परि
- (३) प्रत्ययहरुद्वारा शब्दनिर्माण
  - धातु र प्रत्यय छुटचाउने अभ्यास
  - कृत्प्रत्यय र तद्धितप्रत्यय
- (४) कृत्प्रक्रियाद्वारा शब्दनिर्माण
  - नु, आइ, ओट, आवट, अत, आहा, अक्कड, अन्त, उवा
  - तव्य, य, अनीय
- (५) तद्धितप्रक्रियाद्वारा शब्दनिर्माण
  - आलु, आहा, इया, इयार, इलो, औली
  - य, ईय, क, ता, मान्, वान्, इक, तव्य:
- (६) समासद्वारा शब्दनिर्माण
  - समास: परिचय र वर्गीकरण (तत्पुरुष, कर्मधारय, अव्ययीभाव, बहुब्रीहि, द्विगु, द्वन्द्व)
  - समास र विग्रहको अभ्यास
- (७) द्वित्वप्रक्रियाद्वारा शब्दनिर्माण
  - द्वित्वप्रक्रिया : परिचय र अभ्यास
  - पूर्ण, आंशिक र अपरिवर्तित द्वित्व

एकाइ (इ) वाक्यतत्व र वाक्यान्तरण

(क) क्रिया : पहिचान र प्रकार
(ख) काल : पहिचान र प्रकार
(ग) पक्ष : पहिचान, प्रकार तथा काल र पक्षमा फरक
(घ) भाव : पहिचान र प्रकार
(ङ) वाच्य : पहिचान र प्रकार
(च) पदसङ्गति : पहिचान र अभ्यास
(छ) कारक र विभक्ति : पहिचान र प्रयोग
(ज) वाक्यान्तरण : पहिचान र प्रक्रिया
(झ) वाक्यसंलेषण : प्रक्रिया र अभ्यास
(ञ) वाक्य विश्लेषण : प्रक्रिया र अभ्यास
(ट) उक्ति परिवर्तन : प्रक्रिया र अभ्यास

खण्ड (ख) बोध र अभिव्यक्ति :

(१) बोध : परिचय, शैली र अभ्यास
(२) बुँदा टिपोट : प्रक्रियागत अभ्यास
(३) संक्षेपीकरण : प्रक्रियागत अभ्यास
(४) अनुच्छेद लेखन : प्रक्रियागत अभ्यास
(५) पत्र लेखन : प्रक्रिया र प्रकार
(६) निबन्धरचना : परिचय, रचनाविधि र अभ्यास
(७) कृति समीक्षा
(क) निम्न कृतिहरुको सामान्य समीक्षाको अभ्यास
(१) कविता–
- लेखनाथ पौडचाल : नैतिक दृष्टान्त
- लक्ष्मीप्रसाद देवकोटा : वन
- गोपालप्रसाद रिमाल : परिवर्तन
- बालकृष्ण सम : म पनि द्यौता मान्छु

(२) कथा–
- गुरुप्रसाद मैनाली : नासो
- विश्वेश्वरप्रसाद कोइराला : सिपाही
- इन्द्र कहादुर राई : रातभरि हुरी चल्यो
- रमेश विकल : मधुमालतीको कथा

(३) निबन्ध–
- लक्ष्मीप्रसाद देवकोटा : वीरहरु
- भैरव अर्याल : जयभूँडी
- श्याम प्रसाद : आइमाई साथी

10.2.3. Subject: Physics-II

Description:

The course is a continuation of the first semester.

Contents:

A. Optics

1 Luminosity, luminous flux, lumen, candela and lux.
2 Reflection at plane and irregular surfaces, laws and nature of image: refraction: laws of refraction, total internal reflection, real and apparent depths, refractive indices, refraction prisms and lenses
3 Reflection at curved surfaces, convex, concave mirrors
4 Lens formula, combination of lenses
5 Spectrum and its analysis, kinds of spectrum
6 Optical instruments: visual angle, angular magnification, telescope, microscope and spectrophotometer
7 Velocity of light; Nature of light: Huygen's principle, wave front and its application on reflection and refraction.
8 Interference: constructive and destructive interference, coherent sources,
9 Diffraction: single slit, polarization of light

B. Waves and Sound

1 Types of oscillations, types of waves; transverse and longitudinal, velocity of waves progressive, stationary waves,
2 Newton's formula for velocity of sound; Laplace correction, effect of temperature, pressure and humidity on the velocity of sound,
3 Ultrasonic: its properties and uses in science and technology
4 Beats, Doppler effect, pitch, intensity, loudness and quality of sound
5 Stationary waves in closed and open pipes, vibration of strings, resonance

C. Electrostatics

1 Origin of charges, electrostatic induction, Van de Graff's generator
2 Potential difference, potential energy and gradient, equipotential surfaces,
3 Coulomb's law, Gauss law for electric field, field in hollow conductor
4 Capacitance: between parallel plates: in a sphere, concentric sphere
5 Capacitors: charging and discharging, action of dielectric, dielectric constant, uses

D. Current Electricity

1 Nature of an electric current, metallic conductor
2 Current, EMF and resistance (in series and parallel, resistance box, pd), Ohm's law, ohmic and non-ohmic conductor, use of ammeter, voltmeter and rheostat, application of ohm's law in grouping resistance in cell
3 Heating effect: Joule's laws, thermoelectricity, Seebeck and Pelter effect, thermocouple, thermopile
4 Cells: cells, defects and removal, primary and secondary cells, leads-acid cells, care of cells
5 Law of electrolysis-verification
6 Kirchhoff's laws, Wheatstone bridge principle
7 Magnetic effects of current, moving coil galvanometer, forces on conductors carrying current in magnetic field, Biot and Sevart law, Faraday's laws of electromagnetic induction, induced current and e.m.f., Lenz's law, flux linkage induction coil, principle of AC and DC dynamo, generator, transformer

8 Magnetic induction: in a coil in along solenoid; in a straight wire, Helmhotz coils, Ampere's theorem
9 Fuse, earthing, plugs, single and three-phase line
10 Magnets: pole strength, magnetic moment, magnetic field, intensity, field due to bar magnet, tangent law, hysteresis loss, types of magnetic materials. Earth's magnetism: horizontal and vertical component variation and dip

E. Modern Physics

1 Discharge tube phenomena: electrons, basic unit of charge and its practical nature, Milikan's oil drop experiment, Thomson's method for determining specific charge.
2 Cathode ray, cathode ray tubes, x- rays
3 Thermoionic emission
4 Diode, triode, transistor, Planck's constant
5 Frank-Hertz experiment special theory of relativity
6 Bohr's theory of hydrogen atom
7 Radioactivity, half-life, artificial radioactivity, fission and fusion: Radiation, hazards, safety precaution, and biological effects of radiation

Practical skills

- Verify laws of reflection /refraction
- Determine refractive index of a prism and focal length of a concave and convex lens
- Verify Ohm's law
- Experiment with P.O. box and Wheatstone bridge, potentiometer,Meterbridge
- Locate the poles of a bar magnet/determine ratio of effective length to its real length
- Determine the moment / pole strength of magnet by locating the neutral points
- Use Dip circle
- Use deflection magnetometer and oscilletomagnetoSmeter

Books:

1 A Textbook of Physics, part 1 and 2 – J.M. Pradhan
2 Principles of Physics- Brijlal and Subramanyam
3 Advance Level Physics (5th edition) Nelkon and Parker
4 Numerical Examples in Physics, part 1 and 2, V.K. Shrestha
5 Certificate Level Physics Practical Guide- U.P. Shrestha
6 College physics-F.W. Sears, S.W. Zemanskyi and Young

10.2.4. Subject: Chemistry-II

Description:

This is a continuation of the first semester in basic chemistry.

Contents:

A. Organic chemistry

1. Electronic distribution hydrocarbon (ethane, ethane and ethyne)
2. Hydrocarbons, nomenclature, homologous series and structural formula
3. General methods of preparation and properties of ethane, ethylene and acetylene
4. Principle types of functional groups and the study of representative compounds of the respective functional groups; OH-ethanol, CHO-acetaldehyde, =C=O acetone, COOH-acetic acid, NH_2-methylamine, COOR-acetoacetic ester, $CONH_2$-acetamide, chloroform
5. Aromaticity, preparation and properties of benzene, phenol nitrobenzene, aniline
6. Types of important organics reactions: substitution, addition, condensation, esterification, hydrolysis, polymerization, acetylation, benzylation, ammonolysis

B. Chemistry in service of man

1. Carbohydrates: general idea of sugar (glucose), starch and cellulose
2. Fats and oils: elementary knowledge of fats and oils
3. Proteins: amino acids (introduction)
4. Enzymes: pepsin (elementary knowledge)
5. Vitamins: introduction and deficiency diseases
6. Drugs: aspirin and sulpha drugs
7. Antibiotics: penicillin (introduction)
8. New materials: polymers and plastics, fertilizers, pesticides, fibers, etc.

C. Physical Chemistry

Electrochemistry

1. Theory of electrolytic dissociation, metallic conductors, electrolysis
2. Faraday's law of electrolysis, electrochemical series

Photochemistry

1. Laws of photochemistry
2. Photochemical reaction (brief study)
3. Luminescence, fluorescence, phosphorescence

D. Chemical Equilibrium

1. Energy relation to chemical reaction
2. Acidimetry/alkalimetry and calculations
3. Chemical kinetics: rate reaction, factors affecting rate, order of reaction, activation energy
4. Chemical changes in chemical reactions

E. Titrimetric Analysis

1. General principles: titration procedures, indicator and correct choice
2. Gram equivalents, normal and molar solutions, primary standard solutions ($NaCO_3$, oxalic acid, etc.)
3. Acid-base titration, oxidation-reduction titration

Practical skills

- Determine equivalent weight of Mg and Zn
- Prepare primary and secondary standard solutions
- Determine strengths of acids, bases, and $KmnO_4$
- Measure pH using pH meter
- Detect H_2, N_2, S, and halogens
- Identification of given organic compound
- Salt analysis

Books:

1. Modern Practical chemistry – Y. R. Sharma
2. Elementary Quantitative Analysis – M.K. Sthapit
3. Textbook of Inorganic Chemistry – L.M. Mitra
4. Intermediate Organic Chemistry – B.S. Bahal

10.2.5. Subject: Biology-II

Description:

The course is essentially a continuation of the first semester. Here, the students will receive a more detailed treatment of the subject matter

Contents:

Group-A (Botany)

1 Plant physiology (concept):
   a) Diffusion
   b) Osmosis
   c) Transpiration
   d) Photosynthesis
   e) Respiration
   f) Plant hormones
2 Reproduction:
   a) Vegetative
   b) Asexual
   c) Sexual
3 Genetics:
   a) Concept of heredity
   b) Genetic materials
   c) Mendel's law of inheritance
   d) Linkage
4 Economic botany: General account of: jute, silk, tea and coffee, oils and waxes, medicinal plants, sugar, tobacco, cereals, legumes, fruits, gums and resins
5 Application of biology:
   a) Introduction to biotechnology
      i) Fermentation technology
      ii) Agriculture: biofertilizers and biopesticides
      iii) Tissue culture
      iv) Genetic engineering

Group B (Zoology)

1 Metabolism at the organism level
   a) Digestion
   b) Respiration
   c) Circulation
   d) Excretion
2 Reproduction
   a) Sexual and asexual reproduction in animals
   b) Sex determination
3 Growth: brief embryogenic development of human
4 Evolution: principles of organic evolution, Lamarckism and Darwinism
5 Biodiversity
   a) Habit, habitat, distribution and migratory behavior of fishes and birds
   b) Study of rare and endangered animals of Nepal
6 Pollution: air pollution, water pollution and their effects

7 Nature conservation:
   a) National park
   b) Wild life reserves
   c) Conservation areas
   d) Aforestation and deforestation

Practical skills

- Carry out the osmosis process by potato osmoscope
- Demonstrate transpiration by bell jar experiment
- Demonstrate the necessity of CO_2 in photosynthesis
- Prepare charts on Mendelian inheritance
- Identify/study different types of tissues in plants and animals
- Determine the texture of soil sample
- Determine moisture of soil sample
- Demonstrate the economic value of plants (any two mentioned in the course)

Books:

1 A textbook of biology (part I and II) – S. Agrawal
2 Modern approach botany - Bhatia
3 A textbook of practical zoology –
4 Handbook of botany practical – H.D. Ranjitkar

10.3. THIRD SEMESTER (Common subjects for both Food and Dairy Technology)

10.3.1. Basic Principles of Engineering
10.3.2. Principles of Food Preservation
10.3.3. Milk and Milk products
10.3.4. Basic and Food Microbiology
10.3.5. Fermentation Technology

10.3.1. Subject: Basic Principles of Engineering

Description:

Upon completion of this course the students will understand the basic principles of engineering applied in the food industry.

Contents:

1. Unit, Dimension and their conversion with special reference to SI system
2. Elementary idea of drawing (object)
3. Simple electrical principle: AC and DC current, single phase and 3-phase, electrical motors, motor control, generators, power factor, etc.
4. Simple mechanical principles and power transmission, power, energy, force and their uses
5. Principles of refrigeration: different types of refrigeration units and refrigerants, refrigeration system
6. Study of centrifugal pumps, positive displacement pumps, reciprocating pumps, flow meter, weighing scale, gears and valves
7. Simple engineering works

Practical skills

- Draw different objects
- Carry out study of electrical motor generator
- Carry out study of refrigeration system
- Carry out study of pumps/flow meter/weighing scales/gears/valves
- Perform welding/soldering operations

10.3.2. Subject: Principles of Food Preservation

Description:

Upon completion of this course the students will understand factors affecting food deterioration and the principles and techniques of food preservation.

Contents:

1. Introduction and historical development of food preservation
2. Definition and types of food spoilage, process of food spoilage, and factors affecting spoilage of food.
3. Food preservation by low temperature: effect of refrigeration and freezing on microbial growth, process of freezing, methods of freezing and types of freezer, freezing rate and quality of food, thawing and its method, shelf-life of chilled and frozen food, a few illustrations of food freezing
4. Food preservation by thermal processing: forms of heat treatment, historical development, canning process, heat resistance of microorganisms and factors affecting heat resistance, pH classification of food, container and type of fill, factors affecting heat penetration, methods of heating and types of autoclaves, mode of heat transfer in can, type of pack based on adequacy of sterilization, measurement of sterility and determination of process time, spoilage of canned foods, aseptic canning
5. Food preservation by irradiation: introduction to generation of ionizing radiation, scope of irradiation in food processing, effect of radiation on microorganisms and other biological entities, pasteurization and sterilization effect of irradiation, radiation dose and safety aspect, quality of irradiated foods.

Practical skills

- Perform can reforming operation
- Carry out testing of cans
- Determine the F-value
- Test the adequacy of blanching
- Determine pH/Eh/a_w of food
- Handle processing equipment
- Carry out canning of fruits/vegetables
- Carry out refrigerated storage of meat/fish/eggs

Books

1. The Technology of Food Preservation – N.W. Desrosier and J.N. Desrosier
2. Food Science – N.N.Potter

10.3.3. Subject: Milk and Milk Products

Description:

Upon completion of this course the students will be able prepare pasteurized milk and milk products.

Contents:

1. Collection and reception: platform test, machinery used
2. Pasteurization: principle, method and machinery
3. Standardization of milk
4. Production of ice cream
5. Production of cheese and paneer
6. Production of yoghurt
7. Production of butter
8. Sanitation and hygiene

Practical skill

- Carry out lab test for raw/pasteurized milk
- Perform batch pasteurization of milk
- Prepare ice cream/yogurt/paneer

Books

Dairy Technology – Sukumar De

10.3.4. Subject: Basic and Food Microbiology

Description:

Upon completion of this course the students will get basic knowledge related to basic and microbiology.

Contents:

1. Scope and importance
2. Historical development (including spontaneous generation)
3. Classification of microorganisms
4. Microscopy
5. Nutrition and culture of microorganisms
6. Factors affecting the growth of microorganisms
7. Brief knowledge on: pathogenic microorganisms aerobic organisms thermophilic, mesophilic and psychrophilic microorganisms
8. Introduction to sterilization
9. Aseptic operation
10. Antiseptic and bacteriostatic agents
11. Staining techniques: simple staining (negative staining) and differential staining (endospore, Gram, and ZN staining)
12. Identification of bacteria, yeast and mold
13. General principle underlying food spoilage
14. Sources and prevention of microbial contamination: water, soil, air, etc
15. Brief study of food infection, food poisoning and food borne diseases
16. Basic principles of sanitation
17. Industrial importance of microbiology

Practical skills

- Handle/use microscope
- Prepare/sterilize media/glassware
- Prepare culture
- Carry out inoculation/incubation/isolation of pure culture
- Carry out direct microscopic count/total plate count
- Identify bacteria/yeasts/molds
- Perform microbiological examination of water/milk/food samples/utensils

Books

Microbiology- A.J. Salle
Food microbiology – Frazier
Microbiology –Pelczar
Experiments in basic food microbiology – J.B.K.C and B.K.Rai

10.3.5. Subject: Statistics and Mathematics

Description:

I. **Statistics**: upon completion of this course the students will get knowledge on elementary statistics and their application

Contents:

A. Collection and Organization of Data

1. Definition of Statistics, Scope of Statistics, Functions of Statistics, Limitation of statistics,
2. Data need, Types of data: primary, secondary; Methods of collecting data.
3. Classification, types of classification, Methods of forming class intervals
4. Review of frequency distribution, cumulative frequency distribution, Bi-variate frequency distribution,
5. Tabulation: Different parts of a table, problems related to tabulation.

B. Diagrammatic and Graphic Presentation of Data

1. Difference between diagrams and graphs, Different types of diagrams,
2. Bar Diagrams: Simple, Multiple, Subdivided and Percentage; Pie diagrams.
3. Graphs of frequency distribution: Histogram, Frequency Polygon, Frequency curve,
4. Cumulative frequency curves (Ogives): less than and more than; Ogive curves in estimating percentiles, quartiles and median.

C. Measures of Central Tendency

1. Introduction, Requisites of a good average; mathematical averages: Arithmetic mean,
2. Geometric mean, Harmonic mean. Partition values and Modal values; Computation of Arithmetic mean, Mode and Quartiles for grouped frequency distribution. Selection of an appropriate average

D. Measures of Dispersion

1. Introduction, Requisites of a good measures of dispersion, methods of measuring Dispersion, Absolute and relative measures of range, semi inter quartile range, Average deviation and Standard deviation; Coefficient of variation and related problems.

E. Moments, Skewness and Kurtosis

1. Introduction to moments, Central moments, Moments about any point and their relation (without proof). Definition of skewness, Shapes of some frequency curves, measures of skewness; Idea of Kurtosis and its measure.

F. Correlation and Regression

1. Relation between two variables: Definition of correlation, types of correlation, Scatter diagram, Computation of Karl Pearson's correlation coefficient, Probable error,
2. Correlation coefficient of bi-variate distribution; Spearman's Rank Correlation Coefficient.
3. Regression: Concepts of regression, Lines of regression, Computation of regression lines and regression coefficients; properties of regression coefficients.

G. Probability

1. Introduction, Basic terms used in probability: Random experiment, Trial and Event, Sample space, Decomposable events, exhaustive cases, equally likely cases, favourable cases, mutually exclusive events, independent events;
2. Classical (Mathematical) definition of Probability, Statistical (Empirical) definition of probability;
3. Theorem of total probability and compound probability (without proof), Their uses in calculation of Probability.

H. Concepts of Theoretical Probability Distribution

1. *Binomial Distribution*: Concepts of Bernoulli trials, Introduction of Binomial variate and Binomial distribution, Mean and variance of Binomial distribution (without proof), Use of the formula: $p(x)=C(n,x)\ p^x\ q^{n-x}$ to calculate binomial probability. Combination of probability.
2. *Poisson distribution*: Conditions of using Poisson probability, use of formula $P(x) = e^{-\lambda}\ \lambda^x / x!$; combination of Poisson probability (at least, at most etc.)

I. Concepts of Normal Curve and Normal Distribution

1. Concepts of normal curve, introduction to normal distribution, introduction to standard normal variate and standard normal distribution, properties and advantages of normal distribution, simple problems related to normal curve an standard normal variate.

J. Elementary Idea of Sampling and Estimation

1. *Introduction to Sampling*: Idea of population and sample, Advantages of sampling; Types of sapling: (introduction only) random and non random sampling, Simple Random Sampling, Systematic Sampling, Stratified Sampling.
2. *Introduction to Estimation*: Concepts of population, sāmple, p̄arameter, statistics, estimator and estimates. Properties of a good estimator (introduction only). Estimating population from large sample, Point and Interval estimation. Estimation of $x \pm z_\alpha se(x)$

K. Elementary Idea of Tests of Significance

1. Meaning of significance test, two types of error (type I, type II), confidence limits, critical region, significance level, simple problems related to normality test (z-test); introduction to test of population mean for small sample (t-Test).Concepts of test of goodness of fit (χ^2-test) only for uniform distribution.

II. **Mathematics**: upon completion of this course the students will get basic knowledge in calculus and its applications

Contents:

A. Derivatives and their Applications

1. Review of the concept of derivatives; Derivatives of logarithmic functions, Derivatives of inverse trigonometric functions and exponential functions.
2. Applications of derivatives: Maxima and Minima of simple algebraic functions; Simple problems related to rate measure.

B. Antiderivtives and their Applications

1. Review of Integration: Definite and Indefinite integrals; Introduction to standard integrals, Simple problems related to standard integrals; Definite integrals as limit sum, application of antiderivatives to finding areas;
2. Differential equation: Ordinary differential equation, The standard forms of differential equations: techniques of solving differential equation of first order and first degree (simple problems only)

Practical skills

- Draw bar diagrams/pie chart.
- Draw Histogram/frequency polygon/frequency curve/Ogive
- Compute mean/median/mode for grouped data
- Compute quartile deviation/average deviation/standard deviation.
- Draw the curves/compute skewness of the data
- Find out the relation between the variables (simple correlation/regression of two variables)
- Compute simple probabilities of events; (sum of events/compound events); Simple problems related to binomial theorem/Poisson distribution.

Books

1. A Text book of Statistics – B.C. Bajracharya
2. Elementary Statistics – H.C. Saxena
3. Statistical Methods – Mrigendralal Singh
4. Basic Mathematics volume I and II – M.B. Singh *et al*

10.3.6. Subject: Fermentation Technology

Description

After completing this course the students will get knowledge in the industrial application of microorganisms for the production of fermented foods and beverages

Contents:

1. Introduction to industrial application of microorganisms
2. Microbial growth kinetics
3. Concept of fermentation
4. Fermenter configurations
5. Batch-, continuous-, submerged-, fed-batch-, and solid-state fermentation
6. Production of ethanol
7. Production of beer
8. Production of whiskey
9. Production of wine and brandy
10. Production of fermented foods: sauerkraut, tempeh, sinki, gundruk, kinema
11. Waste treatment

Practical skills

1. Isolate yeasts and molds
2. Prepare wine
3. Prepare ethanol
4. Prepare jand/gundruk/sauerkraut

Books

1. Biotechnology – John E. Smith
2. Biotechnology – R. C. Dubey
3. Industrial Microbiology – A. H. Patel

10.4. FOURTH SEMESTER

10.4.1. Biochemistry and Human Nutrition
10.4.2. Computer Application
10.4.3. Principles of Milk Processing
10.4.4. Dairy Chemistry
10.4.5. Dairy Microbiology
10.4.6. Dairy Engineering
10.4.4. Food Chemistry
10.4.5. Technology of Food Products-I
10.4.6. Food Engineering

10.4. FOURTH SEMESTER (Common subjects for both Food and Dairy Technology)

10.4.1. Biochemistry and Human Nutrition
10.4.2. Computer Application
10.4.3. Principles of Milk Processing

10.4.1. Subject: Biochemistry and Human Nutrition

Description:

After completing this course the students will get knowledge in malnutrition, nutritional value of different foods and their metabolism.

Contents:

1. Introduction to biochemistry
2. Fundamental concepts: bioenergetics, pH, weak acids and bases, buffers
3. Biomolecules: carbohydrate, amino acids and proteins, enzymes, nucleic acids, fats
4. Metabolism of carbohydrates: glycolysis, Krebs cycle, and gluconeogenesis
5. Enzymes: importance, nomenclature and classification, factors influencing enzyme activity, specificity of enzymes, enzyme inhibition, coenzymes and cofactors
6. Introduction : definition and terminologies of human nutrition
7. Function of food: classification and functions of nutrients
8. Calorific values of foods
9. Energy and nutrient requirements, and recommended daily allowances
10. Introduction to digestion, absorption and metabolism of foods
11. Common malnutrition problems and their prevention
12. Introduction to nutritional status and diet assessment
13. Introduction to balanced diet, supplementary food, fortification and enrichment
14. Introduction to nutrition of infants, preschoolers, pregnant and lactating mother
15. Activities of different organizations in the field of nutrition, viz., FAO, WHO, UNICEF

Practical skills

- Carry out qualitative determination of protein/carbohydrate
- Carry out determination of enzyme activity with salivary amylase
- Separate/identify amino acids by paper chromatography
- Conduct nutritional survey: anthropometric/food consumption survey of local area
- Prepare weaning foods

Books

1. Biochemistry – J.L Jain
2. Handbook of practical biochemistry – D.T. Plummer
3. Our Food – M. Swaminathan
4. Human Nutrition and Diet – M. Swaminathan
5. Food and Nutrition Vol. I and II - M. Swaminathan
6. Human nutrition and dietetics – Davidson and Passmore
7. Nutrition in developing countries – V. Kings

10.4.2. Subject: Computer Application

Description:

This subject provides the students the fundamental skills and knowledge about computer system so as to make then able to apply computer skills in Dairy/Food industry.

Content (theory)

- Introduction
  - Evolutions of computers
  - Introduction to computing and computers
  - History of computers
  - Generation of computers
  - Types of computers
    - Analogue and digital
    - Micro, mini, mainframe and super computer
    - Comparison between them in terms of:
      - Speed
      - Memory
      - Storage
  - Number systems
    - Decimal
    - Binary
    - Octal
    - Hexadecimal
  - Boolean algebra
    - AND, OR, NOT, and their combinations
- Computer systems
  - Computer hardware – CPU, VDU, input and output peripherals
  - Computer software – System, Application, & Utility Software
  - Computer memory (RAM, ROM) and storage system (magnetic, optical), types (floppy, hard disk, CDs) and storage capacities.
- Computer Operating System:
  - Importance and uses of operating system
  - Types of operating system and their application:
    - MS-dos
    - Windows
    - UNIX
  - File Management
    - Files and their types
    - Directory and their types
    - Creating and removing subdirectories
    - Attributes
    - Saving and retrieving files
  - Internal and external commands and their uses
  - System files: description and functions:-
    - COMMAND.COM,

  - AUTOEXEC.BAT,
  - CONFIG.SYS.
- Application Program
  - Word processing Package: DOS text editor, MS-Windows based word processing packages, editing and formatting documents.
  - Spreadsheet Package: MS-Windows based spreadsheet packages, editing worksheet and creating chart.
  - Database Package: Creating database, sorting, replacing and listing fields. Report formatting, Screen formatting for data entering.
  - Virus scanning and cleaning
  - Use of proper utility to recover the damaged files in diskette and hard disk
- Installation of Application Software
- Internet and e-mail
- Concept of Networking Environment
- Maintaining the Computer System
- Application of Computer Skills in Dairy/Food Industries.

Practical skills

- Identify/connect the computer/peripheral devices
- Install the operating system
- Apply/Use the operating system
- Install the application software
- Prepare a document in word processor
- Prepare spreadsheet
- Create presentations
- Create database
- Manage database
- Work with internet
- Work with e-mail
- Work in the networking environment
- Maintain the computer system
- Apply computer skills in Dairy/Food technology/industries
- Perform practical skills as many times as possible to develop confidence/expertise

Books

1. MS-DOS Manual, Microsoft
2. MS-Windows, Microsoft
3. Computer Science/Computer Studies – C.S. French
4. Database $^{3+}$, or 4 or 5 as hardware and other facility support
5. System Operation Manuals in use
6. Virus Detection and Clean utilities Manuals.
7. Introduction to Local Area Network – Gee, KCE.

10.4.3. Subject: Principles of Milk Processing

Description

After completing this course the students will get knowledge in the collection of milk and production of pasteurized market milk and other milk products

Contents:

1. Market milk industries in Nepal
2. Collection and transportation of milk – equipment and practices followed in rural milk collection centers, chilling centers, organized farm, cooperatives, use of preservatives
3. Milk reception, clarification, separation, chilling, storage
4. Grading of milk
5. Pasteurization of milk and processing; principles of thermal processing of milk, different methods of pasteurization, bottle fillers, washers, carton filling, powder filling
6. Homogenization of milk: theory of homogenized milk
7. Sterilization of milk: principles and types of sterilization
8. UHT processing of fluid milk: principles of the process, types of plants
9. Aseptic packaging of milk
10. Special milk
11. Recombined milk manufacture

Practical skills

- Carry out milk reception/chilling/clarification/standardization/pasteurization/ packaging/ homogenization
- Prepare flavored milk

Books

1. Market milk and related products. H.H.Sommer
2. Milk production and control. W.C.Harvery and H.Hill
3. Outline of dairy technology. Sukumar De
4. Chemistry and testing of dairy products. H.V.Arthorton and J.N.Newlander

10.4. FOURTH SEMESTER (Specific subjects for Dairy Technology Only)

***Technology specific subjects for Dairy Technology**

10.4.4. Dairy Chemistry

10.4.5. Dairy Microbiology

10.4.6. Dairy Engineering

10.4.4. Subject: Dairy Chemistry (For Dairy Technology)

Description:

The course deals about milk production, constituents & its properties, nutritive value of milk & chemical composition of different milk products etc. The course is designed for Diploma in Dairy Technology students to get general knowledge about Dairy Chemistry. This is a basic course of Dairy Technology.

Contents

1. Primary production of milk, milk secretion, and ejection though udder
2. Composition of cow and buffalo milk
3. Factors affecting composition of milk
4. Milk fat-composition, and properties, saturated and unsaturated fatty acids, rancidity of milk fats
5. Milk protein- amino acid composition, non-protein nitrogenous substances, casein, precipitation/coagulation of casein, whey proteins (introduction only)
6. Lactose: molecular formula, properties, solubility, lactose intolerance
7. Milk ash/citric acid/gases in milk
8. Milk enzymes: definition, lipase, protease, etc. Milk vitamins/minerals: water and fat-soluble vitamins and major & minor mineral constituents, nutritive value of Fe, Ca, P, & Zn present in milk
9. Physicochemical properties of milk: acidity and pH, density, specific gravity, surface tension and viscosity, freezing and boiling points, refractive index, color and flavor, action of milk on metals, freezing point, colloidal properties, oxidation/reduction potential
10. Nutritive value of milk: milk as a nutrient source, nutritional and therapeutic value of milk and milk products
11. Chemical composition of different dairy products: market milk, whole milk, flavored milk, law-fat milk, skim milk, toned milk, reconstituted milk, vitaminized milk, low-sodium milk.

Practical skills

- Carry out sampling of milk for analysis
- Carry out platform testing of milk
- Carry out organoleptic/acidity/pH/ TS/SNF/fat/COB/alcohol test.
- Find out density/specific gravity/viscosity/refractive index/color/flavor of milk
- Carry out adulteration test
- Determine ash/minerals of milk/milk products

Books

1. Fundamentals of Dairy Chemistry. Webb, B.H., Johnson, A.H. and Alford, J.A. CBS publishers and Distributors, New Delhi
2. Chemistry and Testing of Dairy Products. Henry, V., Atherton, J.A., Newlander

10.4.5. Subject: Dairy Microbiology (For Dairy Technology only)

Description:

The course deals about harmful and useful microbes presence in milk and milk products. The course also deals about hygienic milk production; starter cultures used in milk products production, spoilage & deterioration of milk & milk products, microbial growth requirements, etc. The course is designed for Diploma in Dairy Technology students to get general about Dairy Microbiology.

Contents:

1. General introduction to dairy microbiology: types of microorganisms in milk and their morphological and biochemical characteristics
2. Bacteria, yeasts, molds, and viruses
3. Bacteriophage: general introduction only
4. Spoilage of milk and milk products: microbiological aspect of the deterioration of milk products- souring, undesirable fermentation of milk, abnormal milk
5. Hygienic milk production, sources of contamination in milk, changes in milk flora a held at different temperatures, psychrotrophic-, thermophilic-, and thermoduric bacteria
6. Requirements for microbial growth
7. Lactic acid bacteria: classification, lactic acid and flavor production, propagation of starter culture, factors affecting their propagation
8. Use of starter culture in the preparation of fermented milk
9. Propionic acid bacteria
10. Spoilage bacteria
11. Spore forming bacteria
12. Coliform bacteria
13. Pathogenic bacteria
14. Development of bacteria in milk
15. Bacteriological control in dairy
16. Starter cultures

Practical skills

- Conduct sampling of milk
- Perform DMC
- Perform SPC
- Perform Dye Reduction Test
- Perform coliform count
- Determine morphological characteristics of common dairy organisms (size/shape/motility/sporulation/Gram reaction)

Books

1. Dairy microbiology. R.K. Robinson. Elsevier. 1985
2. Microbiology. Paul Stein Jensen and Robert Vorup 1987
3. Dairy bacteriology. Hammer and Babel
4. Standard method for analysis of dairy products
5. Experiments in basic food microbiology. J.B.K.C. and B.K.Rai. 2000

10.4.6. Subject: Dairy Engineering (For Dairy Technology only)

Description

After completing this course the students will get knowledge in different dairy processing equipment and their use

Contents

1. Heat exchangers: plate heat exchangers, application of different types of heat exchangers in dairy industry
2. Cream separator: centrifugal separator
3. Homogenizer
4. Evaporators
5. Pipes, valves and fittings
6. Pumps: working principle
7. Tanks
8. Process control
9. Boilers
10. Cooling
11. Convection and radiation
12. Sanitation equipment
13. sanitary feature of dairy equipment
    a. sanitary pipes and fittings
    b. can washer, milk cans, principle of can washing, types of can washers, crate washers
14. Pasteurization/Sterilization
15. batch and continuous (HTST) pasteurization
    a. metering pump, FDV, holding time
    b. hot water circulation system, regeneration
    c. milk sterilization, principle of sterilization
    d. in-bottle sterilization, autoclave, continuous sterilization
    e. aseptic filling machine
16. Other equipment:
    a. Churners
    b. butter-making machine
    c. cheese vats
    d. ice cream making machine
    e. Filling operation: bottle fillers and capping, pouch filling machine (prepak, aseptic filling)

Practical skills

- Carry out SS pipes/ gasket material/SS milk pump fittings
- Carry out study of milk tankers/milk storage tanks
- Carry out study of the can washer and bottle washer
- Carry out study of Prepak machine
- Carry out study of batch/continuous pasteurizer
- Carry out study of separator and clarifier
- Carry out study of different sterilizer, bottle filling/capping machines

- Carry out study of temperature changes during and production

Books

1. Engineering for dairy and food products. A.W. Farall
2. Experimental methods in food engineering. Rigri and Neihal

10.4. FOURTH SEMESTER (Specific subjects for Food Technology only)

Technology specific subjects for Food Technology

10.4.4. Food Chemistry

10.4.5. Technology of Food Products -I

10.4.6. Food Engineering

10.4.4. Subject: Food Chemistry (For Food Technology only)

Description

Upon completion of this course the students will get knowledge in composition, properties, and functions of different food constituents

Contents:

1. Chemical composition of food
2. Moisture content of food: structure of water, type of water, hydrogen bonding, methods of determination
3. Carbohydrates: classification, structures of glucose, fructose, sucrose, lactose, maltose, starch and pectin
4. Introduction to crude fiber
5. Pectin and its importance
6. Classification of proteins, protein denaturation, determination of proteins
7. Chemistry of fats and oils
8. Vitamins
9. Essential minerals
10. Food additives: natural colors (carotenoids, anthocyanins, chlorophyll), stabilizers, emulsifiers, artificial sweeteners (thaumatin, saccharin, etc.), antioxidants, preservatives (benzoic acid, SO_2), flavor
11. Browning reaction in food

Practical skills

- Determine proximate composition of food items
- Determine reducing/non-reducing sugars
- Determine FFA/peroxide value/refractive index of fat/oil
- Determine SO_2
- Determine benzoic acid
- Determine iron/calcium/phosphorus in food items

Books

1. Food Chemistry – Meyer
2. Food Facts and Principles

10.4.5. Subject: Technology of Food Products (TFP I)

(For Food Technology only) (Cereal Technology)

Description

After completing this course the students will get knowledge in post harvest handling, processing, and storage of food grains

Contents

1. Harvesting, handling and storage
   (a) Introduction and distribution of important cereal grains: wheat, rice, maize, etc
   (b) Post harvest handling of wheat, paddy and maize
   (c) Physical and chemical characteristics and composition of important cereal grain
   (d) Drying: sun and mechanical drying and storage of cereal grains
2. Processing of cereal grains
   (a) Parboiling of paddy and its economic and nutritional importance
   (b) Rice milling methods: Huller and sheller
   (c) Wheat milling: operations and methods, breaking, reduction, milled productions, composition of wheat flour
   (d) By-products of rice, wheat mills and their utilization of husk, bran, broken, germ, etc
3. Technology of cereal products
   (a) Flour quality for different products
   (b) Production of bread and biscuits: raw materials, ingredients, processing methods, quality criteria, defects, packaging, storage
   (c) Noodle-making: ingredients, processing methods, quality criteria, instant noodle preparation, defects, packaging, storage
   (d) Production of breakfast cereals: beaten rice, puffed rice, corn flake
   (e) Malting of barley and other cereal grains
4. Analysis of cereal grains and their products
   (a) Sampling and grading of cereal grains
   (b) Analysis of physical and chemical characteristics of cereal grains
   (c) Analysis of products: bread, biscuit and noodles
   (d) Standards and specification

Practical skills

- Evaluate physical properties of rice in varietal basis
- Prepare parboiled rice
- Carry out milling of paddy
- Carry out grading of rice/paddy
- Carry out milling of wheat
- Determine gluten content of flour
- Prepare bread/biscuit
- Prepare noodles/evaluate the quality
- Carry out industrial visit
- Submit report of the industrial visit

10.4.6. Subject: Food Engineering (For Food Technology only)

Description

Upon completion of this course the students will get knowledge in unit processes and unit operation applicable in food industries

Contents

Units, dimensions and their conversion with special reference to SI system

1. Concept of unit operation: material balance, heat (energy) balance
2. Fluid flow: fluid pressure, elementary concept of pressure and pressure measuring devices, concept of stable type of fluid flow, laminar flow and transfer of fluid (centrifugal pumps)
3. Heat transfer: concept of mode of heat transfer
4. Drying: concept of drying, mass balance, elementary study of dryers (cabinet, tunnel, spray dryer) and their industrial applications
5. Evaporation: study of machinery
6. Introduction to distillation and crystallization
7. Size separation: sieving
8. Size reduction
9. Boilers

Practical skills

- Measure temperature and pressure
- Perform unit operation: traditional/modern rice milling/baking/canning/drying

10.5. FIFTH SEMESTER (Common subjects for both Food & Dairy Technology)

10.5.1. Quality Control and Total Quality Management
10.5.2. Storage and Packaging
10.5.3. Technology of Dairy Products -I
10.5.4. Technology of Dairy Products -II
10.5.5. Technology of Dairy Products –III
10.5.6. Technology of Dairy Products –IV
10.5.3. Technology of Food Products -II
10.5.4. Technology of Food Products -III
10.5.5. Technology of Food Products –IV
10.5.6. Fats and Oils Technology
10.5.6. Sugar Technology

10.5. FIFTH SEMESTER (Common subjects for both Food & Dairy Technology)

10.5.1. Quality Control and Total Quality Management

10.5.2. Storage and Packaging

10.5.1. Subject: Quality Control and Total Quality Management

Description

Upon completion of this course the students will get knowledge on quality, quality control, quality assurance, and quality management

Contents:

1. Introduction: definition, scope, etc
2. Quality attributes
3. Contamination, adulteration and misbranding
4. Food Act, Legislation and Standards
5. Mandatory and Voluntary standards
6. Philosophy of TQM
7. Basic tools of TQM used in food industries
8. The cost of quality
9. Concepts of HACCP, ISO-9000series, KAIZEN, 5-S principle, and Quality Circle
10. Plant lay out
11. Sanitation

Practical skills

- Conduct sampling
- Detect adulteration
- Carry out sensory evaluation

Books

1. TQM for the food industries – W.A. Gould
2. What is TQM the Japanese way – K. Ishikawa
3. Quality Management Handbook- K.K. Ananda

10.5.2. Subject: Storage and Packaging

Description

After completing this course the students will get knowledge on the proper storage of different food products and packaging of different food items in proper packaging materials.

Contents:

A. Storage

1. Introduction to storage of food materials
2. Food losses and damage during storage
   (a) types (b) assessment and (c) factors affecting
3. Grain sampling: theoretical basis, sampling devices and their applications, analysis of grain samples
4. Inspection: grain, stores, handling equipment, milling premises
5. A brief study on the microorganisms, insect pests and rodents, infestation, quality and quantity loss, methods of control (physical, biological and chemical)
6. Storage structure: principle of grain storage, types of storage structures and handling equipment
7. Good storage: practice and warehouse management
8. Study of traditional/rural storage methods

B. Packaging

1. Introduction to packing
2. Principles of packing: physical, biological, biochemical and microbiological hazards and mechanical damage
3. Packing materials: properties and identification, paper and paper board, plastics, aluminum foil laminations
4. Food packages: bags, pouches and wrap, folding cartons, set up boxes, can, collapsible metal, plastic tube, glass container, traditional packages
5. Special problems in packaging of food stuffs: perishable and non-perishable foods
6. Packing standards and regulations
7. Packaging specification and quality control
8. Study on traditional packaging materials

Practicals skills

- Evaluate/control infestation
- Apply fumigation techniques
- Carry out grading/inspection of grains
- Visit warehouses/rural storage structures
- Identify packaging materials: paper/plastics/films
- Perform test of packaging materials (e.g., bottle/can/paper)

Books

1. Handouts provided by the teacher

10.5. FIFTH SEMESTER (Specific subjects for Dairy Technology only)

10.5.3. Technology of Dairy Products -I
10.5.4. Technology of Dairy Products -II
10.5.5. Technology of Dairy Products –III
10.5.6. Technology of Dairy Products –IV

10.5.3. Subject: Technology of Dairy Products-I (For Dairy Technology only)

Description

Upon completion of this course the students will get knowledge on the production, packaging and storage of fermented dairy products

Contents:

1. Butter/Ghee: definition, chemical composition, process of manufacture, operational requirements, churning theory, factors of churning ability, overrun, defects and their removal
2. Cheese: historical origin, definition and classification of cheese. Principle of cheesemaking, milk quality for cheese manufacture, methods of manufacture of cheese, equipment and use and mechanization, use of starter and additives in cheesemaking, difficulties associated with cheese starters, control factors, losses during handling & processing, curing and judging, defects, causes and prevention, cheese yields and payments for cheesemilks. Scientific principles of manufacture of hard, semi-hard, and soft cheeses. Some indigenous cheeses. Role of milk ingredients, outline of manufacture and ripening process.
3. Rennet preparation and properties, rennet substitutes, factors affecting rennin action.
4. Processed cheese: definition, manufacture, cheese spreads, processed cheese foods and cheese powders. Defects, their cause and prevention
5. Packaging, storage, and distribution procedures

Practical skills

- Identify equipment, accessories, cheese varieties
- Enlist factors affecting whey expulsion (syneresis)
- Enlist factors affecting rennin in action
- Prepare hard/semi-hard/soft varieties of cheese
- Prepare cheese spreads
- Study cold storage system of cheese

10.5.4. Subject: Technology of Dairy Products-II

Description

Upon completion of this course the students will get knowledge/skills on the preparation, packaging and storage of non-fermented milk products

Contents:

1. Ice cream: classification, composition, role of milk constituents in ice cream making, sweetener, stabilizers/emulsifiers, optional ingredients, flavoring/coloring materials, calculation and standardization of ice cream mixes, mix processing, freezing, packaging, handling and shipping, defects and their removal, quality control
2. Dried milk and milk products; roller (drum) and spray drying of milk, manufacturing details, packaging/storage, defects and control measures
   a. whole milk powder: standardization of milk, fore-warming, concentration, homogenization, spray/roller drying, properties of powder, packaging and storage, defects, control steps, instantinization of milk powder

   b. skim milk powder: ?
3. Keeping quality of dry milk and sanitation
4. Manufacture of fat-rich dairy products, butter powder, cream powder, chemical control, handling losses
5. Evaporated milk (introduction only)

Practical skills

- Perform calculation/standardization of ice-cream mixes
- Manufacture plain/ flavored/ chocolate/ fruit/nut ice cream
- Manufacture softy ice cream/sherbets/*kulf*i etc

Books

1. Drying of milk and milk products. C.W.Hall and T.I. Hedrick
2. Dairy processing handbook. Tetrapak
3. Outline of dairy technology. S. de
4. Ice cream…Arbuckle, AVI 1984
5. Milk and milk products. Ckarence, Henry Eckles
6. Modern dairy technology. L.N.Lampert
7. Spray drying. K.Masters

10.5.5. Subject: Technology of Dairy Products - III

Description

Upon completion of this course the students will get knowledge/skills on the production, packaging and storage of fermented dairy products

Contents:

1. Fermented milk and milk products: cultured milk, yogurt, *dahi*, acidophilus milk, kefir, cultured dream

   Yogurt: definition, classification, nutritive value, chemical composition, process flow chart, operational requirements, preparation of cultures, factors responsible for good quality, shelf life, common defects and remedies of each product.

   Membrane technology in dairy industry: history, process, membrane filtration, RO, NF, UF, MF, dialysis.

   Protein concentration and fractionation
   - Protein standardization
   - Cheese processes
   - Whey/permeate treatment
   - Bacteria and spore removal
   - Milk protein fractionation

Practical skills

- Prepare/evaluate different types of yogurt/ *dahi*
- Prepare/evaluate different types of acidophilus milk

Books

1. Membrane filtration and related molecular separation technologies-APV Systems
2. Outlines of dairy technology – S. De
3. Dairy processing handbook. Tetra pak
4. Dairy Technology. Vol 1, Danish Turnkey Dairies Ltd. E. Waagner, Nielsen and Jens A. Ullum

10.5.6. Subject: Technology of Dairy Products-IV (For Dairy Technology only)

Description

Upon completion of this course the students will get knowledge/skills on by product utilization and dairy plant sanitation and treatment of dairy effluents

Contents:

Dairy plant hygiene and by-products of milk and milk products
By-products

1. Whey processing, whey protein concentrate
2. Buttermilk
3. Dairy effluent
4. Lactose
5. Minerals
6. Lipids in buttermilk and whey
7. Treatment and uses of dairy effluents
8. Butter milk powder
9. Whey powder/alcohol/cheese

Dairy plant hygiene

1. Importance of sanitation and hygiene in dairy industry
2. Cleaning and sanitation of dairy equipment
3. CIP (introduction only)
4. Detergents and sanitizers used in dairy
5. Cleaning and sanitation procedures
6. Organization pattern of small and large dairy
7. Cost control in dairy

Practical skills

- Analyze whey milk/butter-milk
- Prepare whey drink
- Prepare detergents/ sanitizers solutions in dairy plant
- Analyze dairy effluents

Books

1. Outlines of dairy technology. S.De
2. Dairy handbook. Tetra Pak

10.5. FIFTH SEMESTER (Specific subjects for Food Technology only)

10.5.3. Technology of Food Products -II
10.5.4. Technology of Food Products -III
10.5.5. Technology of Food Products –IV

10.5.3. Subject: Technology of Food Products-II (For Food Technology only) (Fruits and Vegetables)

Description

After completing this course the students will get the knowledge/skills on processing, storage, and preservation of fresh fruits, vegetable and their products

Contents:

1. Maturity standards and criteria of ripening
2. Methods of harvesting
3. Packaging storage: CA, MA, Refrigerated, and hypobaric storage
4. Spoilage factors
5. Fruit canning
6. Fruit drying and dehydration
7. Chemical preservation of fruits and vegetables
8. Concentration
9. Pickling, chutneys, ketchup and sauces
10. Jam, jelly, marmalade

Practical skills

- Prepare jam/ jelly/ marmalade
- Prepare ketchup/pickles
- Prepare RTS

10.5.4. Subject: Technology of Food Products-III (For Food Technology only)

Description

After completing this course the students will get knowledge/skills on chemical composition, processing technology, packaging, and quality evaluation of tea, coffee and spices.

Contents:

Tea

1. Introduction
2. Composition
3. Manufacture of different types of teas
4. Grading

Coffee

5. Introduction
6. Chemical composition
7. Processing technology
8. Quality

Spices

Ginger, turmeric, cardamom, chilly, black pepper etc.

Practical skills

- Extract essential oils
- Prepare *sutho*
- Carryout drying of different spices
- Prepare *masala* powders
- Prepare oleoresins

10.5.5.Subject: Technology of Food Products-IV (For Food Technology only) (meat and poultry)

Description

Upon completion of this course the students will get knowledge/skills on meat animals, their slaughtering and dressing, preparation of fresh meat and processed meat products.

Contents:

1. Meat Animals
2. Pre-slaughter treatment
3. Slaughtering (poultry, pig, etc.)
4. Meat cuts
5. Meat quality parameters and grading
6. Drying, curing, canning of meat
7. Preparation of sausage, ham and bacon
8. Grading of eggs
9. Preservation of whole eggs
10. By-product utilization
11. Bone meal, meat meal, etc

Practical skills

- Carry out slaughtering/ dressing
- Prepare sausage/cured meat/ham/bacon
- Carry out grading of eggs

10.5. FIFTH SEMESTER (Elective (any one, for Food Technology)

10.5.6. Fats and Oils Technology
10.5.6. Sugar Technology

10.5.6. Subject: Fats and Oils Technology

Description

Upon completion of this course the students will get knowledge/skills on the production, packaging and storage of vegetable fats and oils.

Contents

1. Conventional and non-conventional oilseeds
2. Grading
3. Storage and packaging
4. Pressing methods
5. Refining of crude oil
6. Vegetable *ghee* production
7. Margarine
8. Rancidity
9. Utilization of by-products
10. Common adulterants

Practical skills

- Carry out test of adulteration (argemone, cottonseed, sesame, mineral oil)
- Determine Iodine value/Refractive index
- Carry out Baudouin /Hexabromidetests
- Determine Melting point/Free fatty acid/Peroxide value
- Carry out Kries test

Subject: 10.5.6. Sugar Technology

Description

Upon completion of this course the students will get knowledge/skills on the production, packaging and storage of cane sugar and khandsari

Contents:

1. Introduction
2. Characteristics of sugarcane
3. Technology of cane sugar
   (a) juice extraction
   (b) clarification
   (c) concentration
   (d) drying
   (e) factors affecting sugar quality
   (f) machinery
   (g) grading and quality of sugar
   (h) loss of sugar and storage of sugar
4. Analysis of sugarcane and sugar
   (a) cane juice and sugar (raw, white and molasses)
   (b) factor test of cane
   (c) utilization and management of by-products and waste of sugar factory

Practical skills

- Carry out analysis of sugar/cane juice/molasses
- Carry out plant visits

Books

1. Handbook of sugarcane
2. Handbook of canesugar technology

10.6. SIXTH SEMESTER (Common subjects for both Food & Dairy Technology only)

10.6.1. Quality Control and Total Quality Management
10.6.2. Storage and Packaging
10.6.3. On The Job Training (OJT)

10.6.1. Subject: Food Analysis

Description:

After completing this course the students will be able to carry out qualitative and quantitative analysis of different foodstuffs.

Contents:

1. Introduction and its importance
2. Sampling of different food items
3. Statistical treatment of data
4. Proximate analysis of selected foodstuffs
5. Quantitative determination of Vit C
6. Quantitative determination of reducing and total sugars
7. Quantitative determination of SO_2 in food samples
8. Determination of alcohol content in alcoholic beverages
9. Determination of tannins
10. Chromatographic separation and identification of dyes and free amino acids in food samples
11. Total analysis of water
12. Microbiological analysis of foods: *Staph. aureus*, Coliform, *Salmonella*, Total Plate Count

Practical skills

- Carry out sampling of different food items for analysis
- Determine Vit C/reducing sugar/total sugar in food samples
- Determine SO_2 in food samples
- Determine alcohol content in alcoholic beverages
- Determine tannins
- Carry out total analysis of water
- Carry out microbiological analysis of foods: *Staph. aureus*, Coliform, *Salmonella*, Total Plate Count

Books

1. Handbook of Analysis of Fruits and Vegetables by S. Rangana

10.6.2. Subject: Project writing

Description:

Students will carry out project work in-group consisting of a maximum of five students. The institute will assign the topic of project work and guide teacher. The duration of the work shall be of three months. Upon completion of the project work, each group should present their report amid an evaluation committee.

Contents:

1. Introduction to project work
2. Project selection criteria
3. Food plant lay-out
4. Scientific report writing
5. Project evaluation

Practical skills:

- Select/evaluate project
- Prepare project plan
- Carry out the project
- Prepare/present project report

10.6.3. On the Job Training (OJT)

Description:

In this program the students will be placed in job under the supervision of supervisors in the related industries/organizations. The objectives of this program is to make the students familiar with/fain experiences of the world of work as well as to provide them an opportunity to gain skills tat are new or not covered in the training institute.

Nature:

The nature of this program will be of totally practical.

Duration:

The duration of this program will be of 3 months (3×4×39 = 468 hours)

Full marks: 300

Pass marks: 180 (60% 0f full marks)

Eligibility:

After the completion of all the subjects included in this curriculum.

OJT Placement:

- In the related industries/organizations
- The training institute itself should place the students on OJT with provision of compensation.

Evaluation scheme:

S.N.	Who evaluates?	Allocation of marks for evaluation
1	Supervisor of the industry/organization in which the students are placed for OJT	00
2	Related instructor of the training institute	50
3	CTEVT or assigned institute/technical personnel by CTEVT	50
	Total	300

Practical skills:

- Develop job-related administrative skills
- Carry out the related administrative task
- Be professionally socialized
- Deal with the actors of the occupational system
- Develop job-related technical skills
- Carry out job-related technical tasks/skills
- Identify related technical skills/tasks:
    - Not covered in the training institute
    - That are new/important for the job
- Carry out tasks:
    - Not covered in the training institute
    - That are new and important for the job
- Repeat tasks/skills for confidence build ups

On The Job Training

- Seek help/instructions from supervisor(s) while exercising the tasks/skills
- Develop log book/daily diary
- Gain experience of the world of work
- Develop professionally
- Feel pride of job.

11. Certificate requirement

Students should pass all subjects included in this curriculum to get the certificate of Three-years Diploma in Food/Dairy Technology.

12. Facilities

The academy has well-equipped classroom and laboratories. It has computers, a resourceful library. Other facilities include hostel, cafeteria, and playground.

13. Grading system

Grading is based on the marks the students obtain in the examination. Divisions are awarded as follows:

80%: distinction

65%: first division

50%: second division

40%: pass

14. Instructors' qualification

Master degree for general subjects

A minimum of Bachelor degree for technical subjects

All the instructors have good communicative/instructional skills. They all have at least 5 year's experience in related fields.

15. Students' evaluation details

External:Internal examination = 80:20

Continuous performance evaluation for practical works

Internal assessment: at least two internal assessments for each subject per semester

External exam totally controlled by CTEVT

OJT evaluation is conducted by industry, training institute and CTEVT (with 100 marks each).

16. List of tools/equipment

1.	Abbe butyrorefractometer	13.	Hot air oven
2.	Autoclave	14.	Incubator
3.	Centrifuge	15.	Kjeldahl nitrogen set
4.	Colorimeter	16.	Muffle furnace
5.	Computer	17.	Overhead projector
6.	Deep freeze	18.	Pan balance
7.	Desiccator	19.	pH meter
8.	Distillation set	20.	Projection microscope
9.	Electronic balance	21.	Triple beam balance
10.	Freeze/Refrigerator	22.	Water jet vacuum creator
11.	Gerber centrifuge, 1400 rpm	23.	Chemical balance
12.	Heating mantle		

17. Reading materials (third semester onwards)

The Technology of Food Preservation – N.W. Desrosier and J.N. Desrosier

Food Science – N.N.Potter

Dairy Technology – Sukumar De

Food Microbiology – Frazier

Microbiology –Pelczar

Experiments in Basic Food Microbiology – J.B.K.C and B.K.Rai

A Text book of Statistics – B.C. Bajracharya

Elementary Statistics – H.C. Saxena

Statistical Methods – Mrigendralal Singh

Basic Mathematics volume I and II – M.B. Singh *et al*

Biotechnology – R. C. Dubey

Biochemistry – J.L Jain

Handbook of Practical Biochemistry – D.T. Plummer

Food Chemistry – Meyer

Food Facts and Principles

Microbiology. Paul Stein Jensen and Robert Vorup 1987TQM for the food industries – W.A. Gould

What is TQM the Japanese way – K. Ishikawa

Quality Management Handbook- K.K. Ananda

Dairy processing handbook. Tetra pak

Dairy Technology. Vol 1, Danish Turnkey Dairies Ltd. E. Waagner, Nielsen and Jens A. Ullum

Handbook of canesugar technology

Handbook of Analysis of Fruits and Vegetables - S. Rangana

18. Personnels involved (preparation of curriculum)

Prof. Jagat Bahadur K.C.	- Asst. Dean, CCT, Hattisar, Dharan
Mr. Dhan Bahadur Karki	- Lecturer (Food Tech.), CCT, Hattisar, Dharan
Mr. Ram Prasad Khatiwada	- Lecturer (Statistics), CCT, Hattisar, Dharan
Mr. Pushpa Acharya	- Lecturer (Food Tech.), CCT, Hattisar, Dharan
Mr. Syam Kumar Mishra	- Lecturer (Food Tech.), CCT, Hattisar, Dharan
Mr. Basanta Kumar Rai	- Lecturer (Food Tech.), CCT, Hattisar, Dharan
Mr. Jeeban Chandra Dahal	- Senior Curriculum Officer, Curriculum Division, CTEVT