CURRICULUM

DIPLOMA

Food and Dairy Technology

(Three Year's Program - Semester System)

Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

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Introduction:

Diploma in Food and Dairy Technology is one of the prominent and popular disciplines within the technical education in Nepal. Food inspection profession has been helping the world to assure quality food production and it has also been creating salary base employment and self-employment opportunities in public and private sectors. This curriculum is based on the academic requirements to enter bachelor as well as designed with the purpose of producing middle level technical workforce equipped with knowledge and skills related to the field of food and dairy technology so as to meet the demand of such workforce in the country to contribute in the national food quality of Nepal. The knowledge and skills incorporated in this curriculum will be helpful to deliver the individual needs as well as national needs in the field of quality especially in food and dairy sector.

The foundational subjects like English, Nepali, Physics, Chemistry, and Mathematics (offered in diffusion model of curricular programme) are applicable in the technical field. The disciplinary subjects of food and dairy are included in all four semesters. This curricular programme also makes the provision of project works as well as work experience program (WEP*)* in the specific areas, which can be very instrumental in helping the students develop analytical skill and confidence. The curriculum structure and the subject wise content reflect the details of this curriculum. In brief, this curriculum will guide to its implementers to produce competent and highly employable middle level technical workforces in the field of food and dairy industry.

Curriculum Title:

Diploma in Food and Dairy Technology

Aim:

The program aims to produce middle level technical personnel with sound academic knowledge equipped with perfect technical skills that can be faced in real life situation.

Program Objectives:

After the completion of this program, the graduates will be enabled to:

- Apply the professional knowledge and skills in the respected field of food technology
- Develop the positive attitudes towards the professions with greater initiative and self-confidence
- Apply critical thinking for problem-solving and decision making during the service delivery.
- Follow the quality standards set by the organization for quality assurance of the services offered to the customer.
- Get employment in governmental, semi-governmental, non-governmental organization as well as other projects and programs.
- Start their own enterprise and create employment.

Target Location:

The target location of this program will be all over Nepal.

Group Size:

The group size will be maximum of 40 (forty) in a batch.

Entry Criteria:

- SLC Pass or SLC/SEE with minimum C grade in any two subjects and D+ in any one subjects of Compulsory Mathematics, English & Science.
- TSLC in Food technology with minimum 66.68%.
- Should pass entrance examination as administered by CTEVT.

Duration:

The total duration of this curricular program is three years. The program is based on semester system. Moreover, one semester consists of 19.5 weeks and one academic week consists up to 40 hours excluding evaluation period.

Medium of Instruction:

The medium of instruction will be in English and/or Nepali.

Pattern of Attendance:

Minimum of 90% attendance in each subject is required to appear in the respective final examination.

Teacher and Student Ratio

The ratio between teachers and students must be:

- Overall ratio of teacher and student must be 1:10 (at the institution level)
- 1:40 for theory and tutorial classes
- 1:10 for practical classes

Qualification of Teachers and Instructors:

- The program coordinator should be a master's degree holder in the related area.
- The disciplinary subject related teacher should be a bachelor's degree holder in the related area.
- The demonstrators should be diploma degree holder in the related area with three years experiences in training activities.
- The foundational subject related teacher should be master degree holder in the related area.

Instructional Media and Materials:

The following instructional media and materials are suggested for the effective instruction and demonstration.

- ***Printed Media Materials*** (Assignment sheets, Hand-outs, Information sheets, Individual training packets, Procedure sheets, Performance Check lists, Textbooks etc.).
- ***Non-projected Media Materials*** (Display, Flip chart, Poster, Writing board etc.).
- ***Projected Media Materials*** (Opaque projections, Overhead transparencies, Slides etc.).
- ***Audio-Visual Materials*** (Audiotapes, Films, Slide-tape programs, Videodiscs, Videotapes etc.).
- ***Computer-Based Instructional Materials*** (Computer-based training, Interactive video etc.)

Teaching Learning Methodologies:

The methods of teachings for this curricular program will be a combination of several approaches such as; illustrated lecture, tutorial, group discussion, demonstration, simulation, guided practice, fieldwork, block study, industrial practice, report writing, term paper presentation, heuristic and other independent learning exercises.

Theory: Lecture, discussion, assignment, interaction, seminar, group work.
Practical: Demonstration, observation, guided practice, self-practice, industrial practice and project work.

Mode of Education:

There will be inductive and deductive mode of education.

Examination and Marking Scheme:

a. Internal assessment

- There will be a transparent/fair evaluation system for each subject both in theory and practical exposure.
- Each subject will have internal assessment at regular intervals and students will get the feedback about it.
- Weightage of theory and practical marks are mentioned in course structure.
- Continuous assessment format will be developed and applied by the evaluators for evaluating student's performance in the subjects related to the practical experience.

b. Final examination

- Weightage of theory and practical marks are mentioned in structure.
- Students must pass in all subjects both in theory and practical for certification. If a student becomes unable to succeed in any subject s/he will appear in the re-examination administered by CTEVT.
- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

c. Requirement for final practical examination

- Professional of relevant subject instructor must evaluate final practical examinations.
- One evaluator in one setting can evaluate not more than 20 students.
- Practical examination should be administered in actual situation on relevant subject with the provision of at least one internal evaluator from the concerned or affiliating institute led by external evaluator nominated by CTEVT.
- Provision of re-examination will be as per CTEVT policy.

d. Final practicum evaluation will be based on:

- Institutional practicum attendance - 10%
- Logbook/Practicum book maintenance - 10%
- Spot performance (assigned task/practicum performance/identification/arrangement preparation/measurement) - 40%
- Viva voce :
  - Internal examiner - 20%
  - External examiner - 20%

e. Pass marks:

- The students must secure minimum 40% marks in theory and 50% in practical. Moreover, the students must secure minimum pass marks in the internal assessment and in the semester final examination of each subject to pass the subject.

Provision of Back Paper:

There will be the provision of back paper but a student must pass all the subjects of all year within six years from the enrollment date; however there should be provision of chance exam for final year students as per CTEVT rules.

Disciplinary and Ethical Requirements:

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by the review of the disciplinary review committee of the institute.
- Dishonesty in academic or practical activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms in institute, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

Grading System:

The following grading system will be adopted:

- Distinction: 80% and above
- First division: 65% to below 80%
- Second division: 50 % to below 65%
- Pass division: Pass marks to Below 50%

Certification and Degree Awards:

- Students who have passed all the components of all subjects of all 3 years are considered to have successfully completed the course.
- Students who have successfully completed the course will be awarded with a degree of **"Diploma in Food and Dairy Technology"**.

Career Opportunity:

The graduates will be eligible for the position equivalent to Non-gazette 1st class/Level 5 (technical) as prescribed by the Public Service Commission of Nepal and other related agencies. The graduate will be eligible for registration with the related licensing organization of the country (if any).

Course Structure

(Diploma in Food and Dairy Technology)

Year: I **Part: I**

Semester: First

S. N.	Subject	Modes			Distribution of Marks						Total Marks
					Theory			Practical			
					Internal	Final	Time	Internal	Final	Time	
		Th	Pr	Total	Marks	Marks	Hours	Marks	Marks	Hours	
1	English – I	8	0	8	20	80	3	0	0		100
2	Mathematics	8	0	8	20	80	3	0	0		100
3	Physics – I	6	2	8	15	60	3	10	15	3	100
4	Chemistry – I	6	2	8	15	60	3	10	15	3	100
5	Biology – I	6	2	8	15	60	3	10	15	3	100
Total		34	6	40	85	340		30	45		500

Year: I **Part: II**

Semester: Second

S.N	Subject	Modes			Distribution of Marks						Total Marks
					Theory			Practical			
					Internal	Final	Time	Internal	Final	Time	
		Th	Pr	Total	Marks	Marks	Hours	Marks	Marks	Hours	
1	English – II	8	0	8	20	80	3	0	0		100
2	Nepali	8	0	8	20	80	3	0	0		100
3	Physics – II	6	2	8	15	60	3	10	15	3	100
4	Chemistry – II	6	2	8	15	60	3	10	15	3	100
5	Biology – II	6	2	8	15	60	3	10	15	3	100
Total		34	6	40	85	340		30	45		500

Year: II **Part: I**

Semester: Third

S.N	Subject	Modes			Distribution of Marks						Total Marks
					Theory			Practical			
		Th	Pr	Total	Internal Marks	Final Marks	Time Hours	Internal Marks	Final Marks	Time Hours	
1	Basic Principles of Engineering	6	2	8	15	60	3	10	15	3	100
2	Principles of Food Preservation	4	2	6	10	40	2	10	15	3	75
3	Principles of Milk Processing	4	2	6	10	40	2	10	15	3	75
4	Basic and Food Microbiology	4	2	6	10	40	2	10	15	3	75
5	Statistics and Mathematics	6	2	8	15	60	3	10	15	3	100
6	Principles of Fermentation Technology	4	2	6	10	40	2	10	15	3	75
Total		28	12	40	70	280		60	90		500

Year: II **Part: II**

Semester: Fourth

S.N	Subject	Modes			Distribution of Marks						Total Marks
					Theory			Practical			
		Th	Pr	Total	Internal Marks	Final Marks	Time Hours	Internal Marks	Final Marks	Time Hours	
1	Human Nutrition	6	2	8	15	60	3	10	15	3	100
2	Computer Application	2	4	6	5	20	2	20	30	3	75
3	Milk and Milk products	4	2	6	10	40	2	10	15	3	75
4	Food Chemistry	4	2	6	10	40	2	10	15	3	75
5	Technology of Food Products - I (Cereal Technology)	3	3	6	10	40	2	10	15	3	75
6	Food Engineering	5	3	8	15	60	3	10	15	3	100
Total		**24**	**16**	**40**	**65**	**260**		**70**	**105**		**500**

Year: III **Part: I**

Semester: Fifth

S.N	Subject	Modes			Distribution of Marks						Total Marks
					Theory			Practical			
					Internal	Final	Time	Internal	Final	Time	
		Th	Pr	Total	Marks	Marks	Hours	Marks	Marks	Hours	
1	Food Safety and Quality Control	4	2	6	10	40	2	10	15	3	75
2	Storage and Packaging	4	2	6	10	40	2	10	15	3	75
3	Technology of Food Products - II (Fruits and vegetable)	4	4	8	10	40	2	20	30	3	100
4	Technology of Food Products - III (tea , coffee and spices)	4	2	6	10	40	2	10	15	3	75
5	Technology of Food Products - IV (meat, poultry and fish)	3	3	6	10	40	2	10	15	3	75
6	Technology of Dairy Products	4	4	8	10	40	2	20	30	3	100
Total		**23**	**17**		**60**	**240**		**80**	**120**		**500**

Year: III **Part: II**

Semester: Sixth

S.N	Subject	Modes			Distribution of Marks						Total Marks
					Theory			Practical			
					Internal	Final	Time	Internal	Final	Time	
		Th	Pr	Total	Marks	Marks	Hours	Marks	Marks	Hours	
1	Food Analysis	2	6	8	5	20	2	30	45	3	100
2	Project Work	2	6	8	5	20	2	30	45	3	100
3	Work Experience Program	0	24	24	0	0		200	100	3	300
Total		**4**	**36**	**40**	**10**	**40**		**260**	**190**		**500**

First Semester

English- I

Credit Hour: 8 hours/w **Full Marks: 100**
Total hours: 156
Semester: I

General objectives:

This course is designed with a view to provide students with techniques in the use of English for academic and communicative purposes, train them in the functional, notional and grammatical areas of English language uses, make them see the relationship between structure and meaning and teach them structures in a context. This course will to lead students from Intermediate to upper level of English proficiency and guiding them from general to comprehensive understanding of written tasks.

Unit 1: Core English-

The core English text for teaching language skills contains the following units:

Course Introduction	**Time hour**
Part I: Core English (Grammar and writing)	**Time hours 100**
Unit 1:Experiences and achievements	**Theory Time hrs 12**
Objectives	Contents
1. Make sentences using past simple and present perfect continuous 2. Express new experience using active and passive gerund 3. Write job applications	• Was/were/did/had • visited/have visited /have you ever visited/ shouted/ have you ever been shouted • have/has ever/never • be used + singing • be used + being invited • be used + having something done • Job applications
Evaluation methods: written exams, internal assessment, and performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, solving related problems and classroom exercises.
Unit 2:Appearances	**Theory Time hrs 12**
Objectives	Contents
1. Judge someone from appearance using sense verbs 2. Describe peoples' physical appearance 3. Use vocabularies for facial feature	• Look+adjective • Look like+ noun • Look+as if/ as though + clause • Seem to be + adjective • Seem to be+to v1 • Seem to be+have+v3

	• Has/has got • Police Description • Vocabularies
Unit 3. Relating past events	**Theory Time hours 12**
Objectives	Contents
1. Describe earlier events using past perfect tenses 2. Use non defining relative clause 3. Write essay	• Had stopped/had been stopped • Had been trying/had done • Who/whom/which/where/when • Essay writing
Unit 4. Attitudes and Reactions	**Theory Time hrs 12**
Objectives	Contents
1. Express attitude using verb and adjectives 2. Express attitude strongly 3. Express person's character 4. Comprehend the text	• X annoys me • I am/get annoyed by X • I find X annoying. • If there is one thing+ subject or object +relative clause • One thing/ what/ The thing that +attitude verb +me about them is the way + clause • Comprehension passage
Unit 5. Duration	**Theory Time hrs 12**
Objectives	Contents
1. Make questions using duration structures How long?, for/until, in/by 2. Make sentences using take and spend in activities and achievements 3. Make sentences with take, spend and depends on	• How long did you play cards for? • How long did you spend playing cards? • How long did it take to write an essay? • X didn't happen for /till(time) • It was (time) before X happened. • How long does it take to…….? • It can take/ takes….to…..

Unit 6. Reporting	**Theory Time hrs 14**
Objectives	Contents
1. Change tenses involved in reported speech 2. Report the sentences using special reporting verbs 3. Write dialogue	• Is going to/= was going /would • Present = past • Present perfect} • Past }= Past perfect • Past perfect } • Speaker+ said/admitted/denied etc that • Speaker+ assured/warned/told me that • Speaker accused + listener(me)of+v4 • Speaker agreed/refused etc to +v1 • Speaker advised/urged/begged me to + v1 • Speaker suggested that I should +v1 • Speaker insisted on +v4 • Dialogue
Evaluation methods: written exams, internal assessment, and performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, solving related problems and classroom exercises.
Unit 7: Deductions and explanations	**Theory Time hrs 12**
Objectives	Contents
1. Make deductions 2. Give reasons using conditionals with if	• must, may/might, can't+ present infinitives • I'm sure he works/doesn't work hard - He must/ can't work hard • I'm sure he works/doesn't work hard – He must be / can't be working hard. • I'm sure he was working hard- He must have been working hard • Perhaps he is at home – He may/ might be at home. • He can't be a doctor because he didn't know what hepatitis was.
Unit 8: Advantages and disadvantages	**Theory Time hrs 10**
Objectives	Contents
1. Describe the things using effect verbs 2. Listing advantages and disadvantages 3. Advise on a course of action in terms of its advantages and disadvantages 4. Comprehend the passage	• Subject +enable/allow/encourage/force +someone to do something • Subject+ make it easier for someone to do something • Subject+ stop/prevent/save/discourage +someone from doing something • The /one/the main/another+ disadvantages of/drawback of+ being unemployed is that….

	• There is no point in+v4 • You ought to/ ought not to/might as well+v1 • Comprehension Passage
Part II: Extensive Reading and Writing	**Theory Hrs. 56**
Objectives	
1. Interpret the prescribed texts related to different literary genres. 2. Answer the questions based on the reading texts. 3. Produce different types of free compositions.	
Contents	Objectives
Poems	Theory hrs. (3×5 = 15)
	• The grandmother, Ray your Bear • The Lamentation of the old Pensioner, W.B. Yeats. • Full fathom five thy father lies, Shakespeare
Story	Theory hrs. (6+6+7= 19)
	• About love, Anton Chekhov • A story, Dylan Thoma • The Last Voyage of the Ghost Ship
Essays	Theory hrs (8+6+8= 22)
	• Two long-term problems; Too many people; Too few trees, Moti Nissani. • Hurried Trip to Avoid a Bad Star, M. Lilla and L. Bishop Berry. • I have a Dream, Martin Luther King, Jr.

Mathematics-1

Credit hours: 8+0 hrs/week
Total hours: 156 **Full Marks: 100**
Theory 156
Practical: 0

Course Description

This course in mathematic is designed to provide student to use mathematics skills necessary for application in Food and Dairy Technology. The course emphasizes both quantitative and qualitative aspects of Mathematics, involving mathematical derivation and concepts.

Course Objectives

On completion of this course the student will be able to:

- Apply mathematical skills to solve problems related to Food and Dairy.
- Demonstrate the basic understanding of the techniques, principle and applications of differential calculus.
- Demonstrate the basic understanding of the techniques, principle and applications of integral calculus.
- Solve differential equations.
- Solve trigonometrical equations & simple height and distance problems.

Minimum Standards:
The students must achieve a minimum of 40% accuracy in theory.

Recommended Texts

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
6. Bajracharya, D.R., et al., Basic Mathematics, for grade XI and XII National Book Centre, Kathmandu.
7. DAS & B. C Intermediate trigonometry

Course: Mathematics	**Hrs. theory 156**
1. Set theory and real number system	**Hrs. theory 6**
Objectives	Contents
1. Define and denote sets. Types of sets. 2. Find subsets of a set and represent the sets in ven-diagrams.- 3. Find the union, intersection, complement and difference of given sets.	• Concept of sets, specification of sets, representation and types of sets, Venn diagrams, Set operation, set of numbers, Cartesian Products and relation, domain and range of relation.

4. Solve verbal problems using set operations 5. Define real numbers, absolute value, open and 6. closed intervals and inequalities. 7. Use the concept of set in selected problems. 8. Define a set with given examples. 9. Prove that i. AU(BUC)= (AUB)UC, where A,B,C are any three non-empty subset. 10. Write the following in set builder form: 11. (3,5) 12. (-3,9)	• Real number system and the types of numbers, real numbers line, absolute value, open and closed intervals, Inequalities, Inverse function. • (Theorem prof's are not required) • Try only exercise I (1), (2), (3) and (4) from the textbook of grade XI
Evaluation Methods: written Assignments to solve related problems ,written examination, oral tests .	**Teaching / learning activities and resources:** charts, models, graph boards, diagrams, classroom instruction, teachers led discussion, demonstration of solutions illustration through practical examples, text and reference books.
2. Function and graph	**Hrs. theory 6**
Objectives	Contents
1. Define a function 2. Classify function 3. Identify the different functions. 4. Sketch a graph of the various functions. 5. Sketch a graph of trigonometric functions.	• Functions and their inverse and related problems, Function defined as mapping, • Composite functions and related problems, • Algebraic, trigonometric function graph, exponential and logarithmic, hyperbolic function, Try only exercises II (1), • (2), and (3) from the textbook of grade XI
Evaluation methods: written assignments to solve related problems, written examination, oral tests.	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples,text and reference books.
3. Matrices and determinants	**Hrs.theory 8**
Objectives:	Contents
1. Define the term matrix. 2. Write the rows, columns and order of the matrices. 3. Classify matrices according to their properties. 4. Define the addition and multiplication of matrices	• Definition of matrix, notation, order, types of matrices and simple algebra of matrices. Construction of matrix. Condition of addition, substraction and multiplication of matrices.

(of order m X n, with its different types in 3X3 order). 5. Define a determinant and list the properties of a determinant. Define the terms minors and cofactors. Sarrus rule and expanding rule. Define the transpose andadjoin of a matrix. 6. Define the inverse of a matrix.	Adjoint,transpose, inverse of a matrix and related problems. • Definition of a determinant, of a determinant's minor, cofactors and properties of determinants. • Application of matrix and determinant to solve linear system of equation (inverse of matrix and Carmer's Rule) • Try only exercises XII (1), (2) and (3) No.1 to 10 from the textbook of grade XI
Evaluation methods: written assignments to solve related problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, teacher led discussion, demonstration of solutions, illustration through and practical examples, text and reference books.
4. System of linear Equations and Inequalities	**Hrs. theory 3**
Objectives:	Contents
1. Check the consistency of system of linear equations. **2. Solve the system of linear equation by Cramer's rule, matrix method.** **3. Find the solution of three variables by row-equivalent and inverse method.**	• System of linear equation: Linear Equations, Solutions of system of linear equations by row equivalent method, inverse matrix method and Cramer's rule. • System of linear inequalities: Simple Linear Inequalities and their Graphs, • System of Linear Inequalities in two variables, Maximization and Minimization in two variables cases under given linear constrains.
Evaluation methods: written assignments to solve related problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, teacher led discussion, demonstration of solutions, illustration through and practical examples, text and reference books.
5. Polynomial Equation	**Hrs. theory 4**
Objectives:	Contents
1. Solve the polynomial equations. **2. Know the nature of roots of quadratic equations.**	• Review of Polynomial Equation, Factor and Remainder theorem • Fundamental theorem of Algebra (without

3. Solve the value of constant in given equation. **4. Formation of a quadratic equation.**	proof). • Quadratic Equation, Natures of roots of quadratic equation, Relation between roots and coefficients of quadratic equation, Formation of quadratic equation.
Evaluation methods: written assignments to solve related problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, teacher led discussion, demonstration of solutions, illustration through and practical examples, text and reference books.
6. Simple Partial Fraction	**Hrs. theory 3**
Objectives:	Contents
1. Find the partial fractions of given fractions. 2. Solve the simple partial fraction.	• Rational fraction, Problems related to different cases for partial fractions: • Denominator containing i. distinct linear factors ii. repeated linear factors and iii. linear and distinct quadratic factors
Evaluation methods: written assignments to solve related problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, teacher led discussion, demonstration of solutions, illustration through and practical examples, text and reference books.
7. Sequence and Series	**Hrs. theory 4**
Objectives	Contents
1. Define Sequence and series (arithmetic , geometrics , harmonic) 2. Recall the formulae of A.P., G.P. and H.P. 3. Define ratio and proportion and their properties. 4. Sum of infinite geometric series. Define Means.	• Formulae of A.P., G.P and H.P. • Ratio and proportion and their properties. Formula of AM,GM and HM. Relation between AM,GM and HM.
Evaluation methods: written assignments to solve related problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams,

	classroom instruction, teacher led discussion, demonstration of solutions, illustration through and practical examples, text and reference books.
8. Permutation, combination and binomial Expression	**Hrs. theory 9**
Objectives	Contents
1. Describe the basic counting principle. 2. Find the permutation of n-objects taken "r" at a time. 3. Find the combination of n-objects taken "r" at a time, When all objects are different. 4. Find the combination of n- objects taken "r" at a time when all subjects are same. 5. Define permutation and combination of a set of objects. 6. Use the relation P (n, r) and C (n, r) with its properties. 7. Prove the binomial theorem.	• Introduction of basic principle of counting. • Definition of permutation • Formula for finding permutation of n-objects taken r at a time • Application of formula in related problems • Permutation of repeated use of same objects in an arrangement. • Meaning of combination. Application of formula in related problem of combination. • Binomial theorem (Without proof). • Finding general term, middle term and any particular term in the binomail expansion. Binomial coefficients. • Proofs of the relation: P (n, r) and c (n, r) • Try only No. 1 to 10 of exercise II (1), (2), and (3)
Evaluation methods: written assignments to solve related problems, written examination, oral tests.	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, and teacher led discussion, demonstration of solutions, and illustration through practical examples, text and reference books.
9. Trigonometric Function and their Inverse	**Hrs Theory 4**
Objectives	Contents
1. Find the general values of trigonometric equations. 2. Use practical applications of trigonometry. 3. Solve the problems related to inverse circular functions.	• Trigonometrical equations and general values. • Height and distance examples no.1 to 20 from textbook of intermediate trigonometry.

4. Define sine law, cosine law, tangent law, projection law and half angle law. 5. Find the solution of triangle	• Inverse circular functions. • Prove sine law, cosine law tangent law, projection law and half angle law. (Related problem Exercise from the book of grade 11). • Area and solution of traingle.
Evaluation methods: written assignments to solve related problems, written examination	**Teaching /learning activities and resources:** Charts, models, graph boards, diagram classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples.
10. Properties of Triangle	**Hrs Theory 3**
Objectives	Contents
1. Define sine law, cosine law, and tangent law. **2. Define projection law and half angle law.**	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.
Evaluation methods: written assignments to solve related problems, written examination	**Teaching /learning activities and resources:** Charts, models, graph boards, diagram classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples.
11. Coordinate Geometry (Equation of a pair of lines, Straight lines and circle)	**Hrs. theory 18**
Objectives	Contents
1. Find the equation of straight line in three standard forms. 2. Find the equation of straight line in from one point and slope are given (point slope form.) 3. Find the equation of straight line from two given points. 4. Find the angle between two straight lines and condition of perpendicularity and parallelism. 5. Find the length of perpendicular to straight line from a given point. 6. Define line pair equation or express two equations of straight lines as a single equation.	• Equation of straight line in three standard forms. • Find the equation of straight line in from one point and slope are given (point slope form.) • Find the equation of straight line from two given points. • Find the angle between two straight lines and condition of perpendicularity and parallelism. • Find the length of perpendicular to straight line from a given point. • Line pair equation, two equations of straight lines as a single equation.

7. Find the condition required for equation of second degree ($ax^2+2hxy+by^2+2gx+2fy+c=0$) to represent a pair of lines and find the separate equations. 8. Prove that the equation ($ax^2+2hxy+by^2=0$) always represents a pair of lines passing through the origin. 9. Find the angle between two straight lines represented by the homogeneous equations of second degree ($ax^2+2hxy+by^2=0$)	Condition required for equation of Second degree ($ax^2+2hxy+by^2+2gx+2fy+c=0$) to represent a pair of lines and also find the separate equations. • Prove that the equation ($ax^2+2hxy+by^2=0$) always represents a pair of lines passing through the Origin. • The angle between two straight lines represented by the homogeneous equations of second degree ($ax^2+2hxy+by^2=0$) • Try only exercise XI No.1 to 10 from the textbook of grade XI. • 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. • 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. • Definition of circle, equations of circle and related problems, Definition of parabola and ellipse
Evaluation methods: written assignments to solve Related Problems, Written examination	**Teaching /Learning activities and resources:** Charts models graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical example
12. Limits and Continuity	**Hrs. theory 15**
Objectives	Contents
1. Define the term Limit and limiting values. Define indeterminant forms. Evalute the limiting values of simple algebraic & trigonometric Function.	• Limit and limiting values. Limiting values of simple algebraic & trigonometric Function. • Using the formula

2. Use the formula Lt $\frac{X^n - a^n}{X-a}$ $x \rightarrow a$ Lt $\frac{\sin\theta}{\theta} = 1$ (Without Proof) $x \rightarrow \theta$ 3. Define continuity and discontinuity of a function. Identify the continous and discontinuous of a function	Lt $\frac{X^n - a^n}{X-a}$ $x \rightarrow a$ Lt $\frac{\sin\theta}{\theta} = 1$ (Without Proof) $x \rightarrow \theta$ • Define continuity and discontinuity of a function. Identify continous and discontinuous of a function. • Try only exercise XI No.1 to 5 of XVII (1) and (2) • Continuity of a function at a point, Test of continuity.
Evaluation methods: written assignments to problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples, text and reference books.
13. Derivatives and their applications (Maxima and Minima)	**Hrs theory 20**
Objectives	Contents
1. Define the terms derivatives. Apply definition to get derivates of the functions x^n,$(ax+b)^n$, sin(ax+b), cos(ax+b), e^x and logx, $\sin^2 x$, $\cos^2 x$, $\sqrt{sinax}$. 2. Use the sum, difference, product, quotient and chain rule of derivatives to calculate the derivatives of algebric function only. Derivatives of parametric and implicit functions. 3. Apply the derivate to calculate maximum and minimum values of a given algebric function and other related problems.	• Definition of the terms derivatives. Application of the definition to get derivatives of the functions x^n, $(ax+b)^n$, sin(ax+b),cos(ax+b), e^x and logx, $\sin^2 x$, $\cos^2 x$, $\sqrt{sinax}$. • Using the sum, difference, product, quotient and chain rule of derivatives to calculate the derivatives of algebric function only. Derivatives of parametric and implicit functions. • Application of derivate to calculate maximum and minimum values of a given algebric function and other related problems.(Exercises from the book of grade 11 or equivalent)
Evaluation methods: written assignments to problems, written examination	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, and teacher led discussion, demonstration of solutions, and illustration through practical examples, text and reference books.

14. Integration	**Hrs. theory 16**
Objectives	Contents
1. Define integration (Antiderivative). Apply techniques of integration as anti derivate, substitution method, trigonometric substitution, integration by parts and definite integral. 2. Use definite integral to calculate area enclosed by algebric curve, X-axis and ordinate at x=a to x=b.	• Definition of integral as antiderivative, Application of techniques of integration as anti derivate, substitution method, trigonometric substitution, integration by parts and definite integral. • Using definite integral to calculate area enclosed by algebric curve, X-axis and ordinate at x=a to x=b.
Evaluation methods: written assignments to solve related problems, written examination	**Teaching /learning activities and resources:** Charts, models, graph boards, diagram classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples.
Evaluation methods: written assignments to solve related problems, written examination.	**Teaching /learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples.
15. Vectors	**Hrs. theory 6**
Objectives	Contents
1. Define different types of vectors. **2. Find the addition, subtraction and multiplication.** **3. Find the unit vectors, dot product, cases of perpendicularity, scalars product.** **4. Solve simple vector sum.**	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
Evaluation methods: written assignments to solve related problems, written examination.	**Teaching /learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples.

Physics-I

Total hours: 156 **Full Marks: 100**
Theory 117
Practical: 39

Course description

This course in physics is designed to provide students with an understanding of the scientific laws of our physical world, how the physical world and physics contribute to life's activities in modern society also describes how the laws of physics are outcomes of the natural phenomena. The course emphasizes both quantitative and qualitative aspects of physics, involving mathematical models and equations. The application of physics to social and environmental situations is well illustrated.

The practical components of this course are designed to supplement learning through the application of learned theories. The students will handle simple apparatus to do simple measurements, demonstrate simple electrical circuits and apply their knowledge of physics in the real life.

Course objectives

On completion of the course the students will be able to:

- Sustain interest in physics and its application related to everyday experiences of their life.
- Identify the social, economic, environmental and other implications of physics.
- Describe physics as a coherent and developing framework of knowledge based on fundamental theories of the structures and processes of the physical world.
- Demonstrate the skills of experimenting, observing, interpreting data and evaluating evidence to formulate generalizations and models.
- Apply the knowledge of physical principles for familiar and unfamiliar situations.
- Apply facts, vocabulary and convention to unit measurements and common measuring instruments
- Explain the definitions, law concepts theories and models presented in this course.
- Describe the applications and implications of physical facts and principles.

Minimum Standards:
The students must achieve a minimum of 40% accuracy in theory and 50% accuracy in practical.

Recommended text:
A text book of physics by SatyaPrakash Part I & II,
Principles of phsics by HallidayResnick&Jeral Walker
Advance level physics by Nelkon& Parker (5 th edition)
Numerical examples in physics vol. I & II by V.K shrestha
College physics by F.W.Sears, S.W. Zemanskyi& Young
Physics practical guide by U.P. Shrestha
Pradhan J.M. and gupta, S.K, A textbook of physics (part i and ii)
Verma, H.C, Concepts of physics i & ii

Course Contents

Course: Physics-I	**Hrs. Theory 117 Hrs. lab 39**
Unit 1: Mechanics	**Hrs. theory 47**
1.1 units and measurement	**Hrs. theory 6**
Objectives	**Content**
i. Measure precisely mass, length, time, volume, density, pressure and specific gravity. ii. Define fundamental and derived units iii. Explain MKS, CGS and SI system of units iv. Convert one system of units into another system of units v. Express derived units in terms of fundamental units. vi. Use of dimension to derive simple physical quantities and equations	• The use of meter scale, spring balance and physical balance, stopwatch for measurement of length, mass and time. • Basic table of measurement for units of mass, length and time • Explain the physical concept of mass, length and time • Various systems of units and their conversion • Express derived units in terms of fundamental units • Dimensional formula for various physical quantities • Explain use of dimensional equation • To test the correctness of physical equations. • To derive physical equations. • To convert one system of unit in to another system of unit. • To find dimensions of a constant in an equation.
Evaluation methods: written and viva exams, performance observation.	Teaching/learning activities and resources: classroom instruction and demonstration return demonstration models, solving related problems.

Scalars and Vectors	
1.2 scalar and vectors	**Hrs: theory 3**
Objectives	**Content**
i. Differentiate between vectors and scalars. ii. Identify whether a physical quantity is scalar of vector. iii. Resolve vectors into rectangular components. iv. Point out the resultant to two or more vectors by graphical method. v. write the values of scalar product and vector product, for selected problems	• Scalar and vectors with examples • Vectors addition by parallelogram and triangle method • Resolve a vector into two components. • The product of two vectors either results in a scalar quantity or a vector quantity • Simple numerical problems
Evaluation methods: written and viva exams, performance observation	**Teaching/learning activities and resources:**classroom instruction and demonstration, return demonstration models, solving related problems

Kinematics	
1.3 Kinematics	**Hrs: theory 4**
Objectives	**Content**
i. Define displacement, velocity, instantaneous	• Displacement, velocity, instantaneous velocity,

velocity, average velocity, uniform velocity and acceleration retardation ii. Differentiate between distance and displacement, speed and velocity. iii. Write down the relation of kinematics equation of motion (linear and gravitational). iv. Calculate the time of flight, maximum height and horizontal tangs of projectile. v. Solve simple problems related to the projectile.	average and uniform velocity and acceleration (retardation) • Distance and displacement, speed and velocity • The concept of projectile motion • Simple numerical problems
Evaluation methods: written and viva exams, performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration, models, solving related problems

Force	
1.4 Force	**Hrs. theory 10**
Objectives	**Content**
i. State Newton's laws of motion. Give the concept of inertia of rest, motion and direction. ii. Define force in terms of rate of change of momentum and give their directions iii. State and prove principle of conservation of linear momentum with examples. iv. Define angular displacement, angular velocity and angular acceleration, angular momentum, Distinguish between angular velocity and linear velocity and obtain the relation between them. principal of conservation of angular momentum v. Define friction, laws of limiting friction and coefficient of friction vi. Define circular motion, centripetal force and centrifugal force. vii. Differentiate between elastic and inelastic collision.	• Linear momentum and significance of Newton's laws of motion in various concepts, meaning of inertia of rest and inertia of motion. • Applications of inertia and impulse. • Angular displacement, velocity and acceleration. • Derivation of the relation $v=\omega r$ • Vector nature of velocity and change of the direction of velocity in circular motion. • Limiting friction, angle of friction and coefficient of friction. Law of limiting friction. The relation between angle of fraction and coefficient of fraction. • The magnitude of centripetal force and centrifugal force, $F=mv^2/r=mr\omega^2$. • Define and differentiate. • Simple numerical problems
Evaluation methods: written and viva exams, performance observation.	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Work, Energy and Power	
1.5 Work, Energy and Power	**Hrs theory 2**
Objectives	**Content**
i. Fined work energy and power and give their units in various systems. ii. Define KE and PE also give their magnitude. iii. Relation between Watt and Horse power iv. State and verify the principle of conservation of energy.	• The distinctions between the common uses of the term work, energy i.e. change of KE into PE giving example of falling body. • Simple numerical problems
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Simple Harmonic Motion	
1.6Simple Harmonic Motion	**Hrs theory 4**
Objectives	**Content**
i. Define Simple harmonic motion (SHM). ii. Simple Pendulum iii. Analogous between SHM and wave motion.	• Definition of SHM with example. • Derivation of time-period of simple pendulum • Compare and contrast: wave motion and SHM • Solve problems related to SHM.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Gravity and Gravitation	
1.7 Gravity and Gravitation	**Hrs theory 5**
Objectives	**Content**
i. State Newton's law of gravitation. ii. Deduce unit and dimension of G. iii. Define acceleration due to gravity and variation of g with height and depth iv. Differentiate between center of gravity and center of mass. v. Concept of escape velocity	• Laws of gravitation$F=GMm/R^2$ • Acceleration due to gravity, mass and weight. • Derive $g = GM/R^2$ .the relation between gravitation constant and acceleration due to gravity. • The variation of g due to height and depth. • Center of mass and center of gravity. • Derivation of escape velocity • Simple numerical problems
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Hydrostatics	
1.8 Hydrostatics	**Hrs theory 3**
Objectives	**Content**
i. Explain that liquid pressure is proportional to the depth of the liquid and independent of the shape of the vessel. ii. Define density, and specific gravity of solids and liquids. iii. Explain Pascal's law and Archimedes's principle. iv. State the principle of flotation and condition of equilibrium of floating bodies.	• Fluid pressure and determination of the formula $P=\rho gh$. • Pascal's law. • Density and specific gravity. • Difference between density and specific gravity. • Archimedes's principle and its uses. • The Principle of flotation and condition of equilibrium for floating bodies. • Atmospheric pressure with examples.
Evaluation methods written and viva exams, performance observation.	Teaching/learning activities and resources: classroom instruction and demonstration return demonstration models, solving related problems.

Properties of Matter	
1.9 Properties of matter	**Hrs theory 15**
Objectives	**Content**
i. Define elasticity ii. State Hook's law of elasticity. iii. Define stress, strain and Young's modulus of elasticity. iv. Define viscosity. v. State Newton's formula of viscosity. vi. Define coefficient of viscosity. vii. Deduce unit and dimension of viscosity. viii. Define terminal velocity and stoke's law. ix. Define and explain surface tension. x. Explain Adhesive force and cohesive force. xi. Explain phenomenon of capillarity (no derivation of formula).	• Definition of elasticity • Statement of Hook's law of elasticity. • Definition of stress, strain and Young's modulus of elasticity. • Definition of viscosity. • Statement of Newton's formula of viscosity. • Definition of coefficient of viscosity. • Derivation of unit and dimension of viscosity. • Definition of terminal velocity and derivation of stoke's law. • Definition and explain surface tension. • Definition of Adhesive force and cohesive force. • Solve related numerical problems.
Evaluation methods written and viva exams, performance observation.	Teaching/learning activities and resources: classroom instruction and demonstration return demonstration models, solving related problems.

Heat and Thermodynamics	
Unit 2: Heat & Thermodynamics	**Hrs theory 35**
2.1 Thermometry	**Hrs theory 4**
Objectives	**Content**
i. Define heat and temperature and distinguish between them. ii. Describe the sensitivity of a liquid thermometer. iii. Determine the lower and upper fixed points of the thermometer. iv. Define different temperature scales (Celsius, Fahrenheit and Kelvin) v. Convert one temperature scale into another using the temperature conversion formula.	• Concept of heat temperature. • Explain sensitivity of a liquid thermometer. • Demonstrate various types of thermometers and explain their uses. • Derivation of the formula: C/5 = (F-32)/9=(K-273)/5 • Relation between different temperature scales. • Simple numerical problems
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Thermal Expansion	
2.2 Thermal Expansion	**Hrs theory 4**
Objectives	**Content**
a) Describe linear, superficial and cubical expansion of solids and their expansivity. b) State the relation between linear, superficial and cubical expansivity of solids (not derivation). c) Define real and apparent expansion of liquid. d) Explain the change in density of a substance with the variation of temperature.	• Linear, superficial and cubical expansion of solids. • The relations $1_2=1_1[1+\alpha(\theta_2-\theta_1)]$, $A2=A_1[1+\beta(\theta_2-\theta_1)]$, $V2=V_1[1+\gamma(\theta_2-\theta_1)]$. • Concept of $\gamma=3\alpha$ and $\beta=2\alpha$. • Discuss about apparent and real expansion of a liquid. • Change in density of an object due to change in

e) Discuss the density variation of water with temperature (anomalous properties of water).	temperature. • Anomalous expansion of water and its importance to marine life. • Use of water cooling and heating purposes
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Heat Capacity	
2.3 Heat capacity	**Hrs theory 4**
Objectives	**Contents**
a) Define heat capacity, specific heat capacity. b) Distinguish between joule and calories as heat unit. c) Explain the quantity of heat content of a body $Q=ms\theta$. d) Explain the energy required to cause a phase change at constant temperature. e) Define freezing, melting and boiling point of a substance. f) Explain latent heat of fusion and latent heat of vaporization.	• Heat capacity, specific heat capacity. • The relation between joule and calorie. • Melting point, boiling point and freezing point of a substance. • The effect of pressure on melting and boiling point of substance. • Determination of latent heat of fusion of ice by the method of mixture. • Simple numerical problems.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Hygrometry	
2.4: Hygrometry	**Hrs theory 4**
Objectives	**Contents**
i. Explain saturated and unsaturated vapor. ii. Define triple point. iii. Define dew point, absolute humidity and relativity humidity. iv. Determine relative humidity by wet and dry bulb hygrometer.	• Definition of saturated and unsaturated vapors. • Definition of triple point. • Definition of dew point, absolute humidity and relativity humidity. • Determination of relative humidity by wet and dry bulb hygrometer.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
Transfer of heat	
2.5: Transfer of heat	**Hrs theory 4**
Objectives	**Contents**
i. Differentiate between conduction, convection and radiation. ii. Define thermal conductivity with its units. and dimension. iii. Define black body with examples.	• The transfer of heat by conduction, convection and radiation • Thermal conductivity giving its dimension and units • Laws of black body radiation

iv. State the Stefan Boltzmann's law and give an example of its application.	• Solve related numerical problems.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Gases	
2.6: Gases	**Hrs theory 15**
Objectives	**Contents**
i. State Boyle's law and Charle's law ii. Define absolute temperature and absolute Zero. iii. State ideal gas equation. iv. Know the value of R. v. Derive general formula of work done by gas. vi. Define internal energy of gas. vii. State first law of thermodynamics. viii. Define Molar and specific heat capacity of gas. Derive C_p-C_v= R ix. Explain thermodynamic process (Isothermal and adiabatic process) x. Kinetic theory of gas. xi. Find expression for *r.m.s*. speed. xii. Second law of thermodynamics.	• Statement of Boyle's law and Charle's law • Definition of absolute temperature and absolute Zero. • Concept of ideal gas equation. • Know the value of R. • Derivation general formula of work done by gas. • Definition of internal energy of gas. • Statement of first and second law (Clausis and Kelvin) of thermodynamics. • Definition of Molar and specific heat capacity of a gas. • Derivation of C_p-C_v= R • Definition of isothermal and adiabatic process and their equations. • Postulates of kinetic theory of gas, derivation of pressure exerted by a gas, explanation for *r.m.s.* speed. • Solve related numerical problems.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems.

Electrostatics	
Unit 3: Electrostatics	**Hrs theory 20**
3.1: Electrostatics field	**Hrs theory 15**
Objectives	**Contents**
i. Concept of electric charge. ii. State modern theory of electrification. iii. State and explain coulomb's law law. iv. Gauss law and Electric field due to charged sphere. v. Explain the properties of lines of force vi. Define electric field and electric flux. vii. Calculate electric field intensity due several point charges viii. Define electric potential difference, potential energy and electron volt. ix. Explain the equipotent surface	• Concept of electric charge. • Statement of modern theory of electrification. • Coulomb's law for point charges and derivation of the expression for force. • Derivation of electric field due to charged sphere. • Effects of permittivity on a medium between two point charges • Electric field and normal electric flux. • Potential and potential energy • Analogy between electric potential and gravitational potential.

x. Explain the zero potential. xi. Define capacitor, its types and uses. xii. Define capacitance. xiii. Derive E=V/d, for parallel plates capacitor	• Electron volt and its use • Use of capacitor and its types • Definition of capacitance
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Magnetism	
Unit 4: Magnetism	**Hrs theory 15**
4.1: Fundamentals of Magnetism	**Hrs theory 15**
Objectives	**Contents**
i. Explain magnetic field strength, lines of force, magnetic field intensity and permeability ii. State coulomb's law for magnetism iii. Describe the properties of a magnet iv. Calculate magnetic field intensity due to a bar magnet at any pointy on the equatorial and axial line of a bar magnet. v. Trace the lines of force and describe their properties. vi. Define natural point. vii. Describe the dip, declination and horizontal components of earth's magnetic field. viii. Define and give the properties of dia, para and ferromagnetic materials	• Like pole repel and unlike pole attract each other. • Various types of magnets and their positions of poles. • Coulomb's law for magnetism • Magnetic field intensity due to bar magnet at end on position. • Board side on position. • Lines of force around a bar magnet and the natural point. • Uniform and non-uniform magnetic field • Properties of dia,para and ferromagnetic materials
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Physics practical

Diploma: 1st sem. Hrs: 39

Objectives		Lab Hour
1	Determine the volume of a hollow cylinder and a solid cylinder using vernier calipers.	5
2	Determine the volume of steel ball using micro-meter screw gauge.	5
3	Use simple pendulum to determine the value of acceleration due to gravity ‘g’ in laboratory.	5
4	Verify the Archimedes’ principle	4
5	Determine the young’s modulus of elasticity of a given wire by vernier apparatus.	4
6	Plot combine magnetic lines of force due to the earth and the bar magnet placed with **north pole pointing towards north**, to locate natural point and calculate it’s magnetic moment and pole strength of magnet.	6
7	Determine the latent heat of fusion of ice.	4
8	Determine the coefficient of viscosity of liquid (Glycerin, mustard oil)	6

Chemistry-I

Credit hours: 6+2 hours/week
Total hours: 156 **Full Marks: 100**
Theory 117
Practical: 39

Course Description:

This course is designed to give students the fundamental concept of physical, organic and in-organic chemistry. Emphasis is given to the principles related to chemistry within everyday life and to the application of chemistry in Food science. An additional function of the course is to stimulate interest in the application of chemistry and to prepare the student or further study in this field. Chemistry practical acquaints the student with the use of related laboratory equipment and provides practical application of learned theory, which is relevant to Food technology.

Course Objectives: Upon completion of the course, students will be able to:

- Explain the basis chemical changes involved in Chemistry.
- Test the food to make food for edible.
- Apply the knowledge of chemistry for the production of improved quality & hygienic food.
- Utilize chemical principles in laboratory testing.
- Prepare standard chemical & carry out chemical analysis related to food & dairy technology.

Minimum Standards: Students must achieve a minimum of 40% accuracy in theory and 50% accuracy in practical.

Recommended Texts/ Reference Texts:

1. Foundations of Chemistry (Part I) – Taleju Prakashan
2. Elementary Chemical Calculation - Taleju Prakashan
3. Elementary Practical Chemistry – M.K. Sthapit
4. Elementary Qualitative Analysis – Taleju Prakashan
5. Systematic Numerical Chemistry – S.K. Kundra
6. Elementary Organic Chemistry – B.S.Bahl & Arun Bahl
7. Conceptual Chemistry for Class XI – S.K.Jain

Course Contents

Course: Chemistry – I	**Hrs. Theory:117**
Group A	**Physical Chemistry:39**
1.1. Language of Chemistry	**Hrs. Theory 8**
Objectives	Contents
1. To list the symbols of elements, molecule and compound 2. To know the method of separation of mixture by different methods. 3. To study chemical equations and to modify chemical equations more informative. 4. To make chemical equations balanced by different methods.	• Classification of Matters, Symbol of atom, molecule and compound • Chemical compound, Mechanical mixture and their separation(6 methods) • Chemical equation, 6 types, limitations and modifications. • Balancing Chemical equation by : i. Hit & trial method ii. Partial equation Method iii. Oxidation Number method iv. Ion-electron method • Some examples
1.2. Chemical Arithmetic	**Hrs. Theory 8**
Objectives	Contents
1. To express mole in three ways. 2. To determine equivalent weight of salt, acid, base, oxidant and reductant by different ways. 3. To explain applications of Avogadro's Hypothesis.	• Mole Concept: expression in three ways (weight, number & Volume) • Numerical Problems. • Equivalent Mass of Salt, acid, base, oxidant and Reductant • Determination of E.W. by: (i) Hydrogen displacement method, (ii) Oxide formation method • Avogadro's Hypothesis and its applications to deduce: atomicity, relationship between mol. wt. & Vapour density, molar volume & molecular formula • Numerical Problems.
1.3. States of Matter(liquid/solid)	**Hrs. Theory 7**
Objectives	Contents
1. To define solubility and solve problems based on solubility. 2. To explain solubility curves. 3. To express concentration of solution in different ways. 4. To discuss types of crystals.	• Physical Properties of Liquid: Evaporation, Vapour Pressure, Boiling Point, Surface Tension & Viscosity • Solution & their types: based on size of particles & capacity of solvent to dissolve solute. • Solubility and solubility Curves, applications. • Numerical Problems • Ways of expressing concentration of solution in terms of Normality & Molarity • Crystalline and Amorphous solid (Different only), Properties of Crystal: Effloscence, Deliquescence & Hygroscopy
1.4. Electrochemistry	**Hrs. Theory 8**
Objectives	Contents
1. To define different types of electrolytes. 2. To explain different types of electrodes.	• Types of Electrolytes: Strong & weak (true & Potential), Spectator ions. • Arrhenius Theory of Ionization and its drawbacks • Types of Electrode: Inert or Non-attackable & Attackable /

3. To derive Faradays laws and their applications. 4. To know different types of conductance.	Electrolysis & Mechanism of electrolysis • Criteria of Product Formation during electrolysis/ Applications of electrolysis • Faraday's laws of electrolysis (1st& 2nd laws) • Numerical problems • Specific, Equivalent & Molar Conductance of electrolytes- definition/formula/variation with dilution
1.5. Electronic theory of valency and Bonding	**Hrs. Theory 8**
Objectives	Contents
1. To write postulates of electronic theory. 2. To explain characteristics of different type of bonds. 3. To draw Lewis structure. 4. To determine dipole moment and its applications.	• Basic assumptions of Electronic theory, Octet Rule • Ionic Bonds, Covalent bonds and Co-ordinate Covalent bonds, their characteristics • Resonance • Lewis Structure of Compounds • Vander Waal's Force: Hydrogen bond & types. • Applications of Hydrogen Bond. • Dipole moment & its applications • Polar and Non- Polar Covalent Compounds
Group B	**Inorganic Chemistry: 36**
2.1. Atomic Structure	**Hrs. Theory 8**
Objectives	Contents
1. To study comparative study of sub atomic particles. 2. To define different sub atomic particles. 3. To explain Rutherford's theory, Bohr's theory and modern wave mechanical theory.	• Comparative study of fundamental atomic particles: discovery, nature, weight, charge, specific charge, location, stability & antiparticle. • Isotopes, Isobars, Isotones, Nuclear isomer, Isodiapheres, Isosters & Isoelectronic species. • Rutherford's Atomic model & limitations • Bohr's theory: postulates • Origin of Hydrogen spectrum. • Limitations of Bohr's Theory. • Concept of wave & Particle nature, De-Broglie's Hypothesis & significance. • Heisenberg's Uncertainty principle & applications.
2.2. Periodic Table	**Hrs. Theory 8**
Objectives	Contents
1. To know different periodic laws. 2. To explain Mendeleev's and Modern periodic table. 3. To classify elements. 4. To explain different periodic properties and their periodic trends.	• History of Periodic table: Basis of classification according to Lavoisier, Proust, Doberiener & Newland. • Mendeleev's Periodic table: law, advantages & limitations. • Modern periodic table: law, advantages & limitations. • Classification of elements on the basis of (a) differentiating electrons & (b) incomplete shells. • Causes of periodicity, periodic properties • Atomic size, ionic size, periodic trends. • Ionization energy, factors & periodic trends • Electron affinity & Electronegativity, general periodic trends.

2.3. Acid, Base & Salt	**Hrs. Theory 5**
Objectives	Contents
1. To explain different concepts of acid-base theories. 2. To define salt. 3. To explain about the concept of salt hydrolysis.	• Definition of acid & base according to Arrhenius concept, limitations. • Definition of acid & base according to Bronsted -Lowrry concept, limitations. • Definition of acid & base according to Lewis concept, limitations. • Definition of salt, types • Qualitative concept of Hydrolysis of salt.
2.4. Hydrogen	**Hrs. Theory 4**
Objectives	Contents
1. To define different form of Hydrogen. 2. To explain isotopes and nuclear isomers. 3. To define methods of removal of hardness by temporary and permanent methods.	• Molecular, Atomic, Nascent & Occluded Hydrogen : preparation, general properties & applications • Isotopes of Hydrogen; uses/ Ortho & para Hydrogen. • Water: Physical & chemical properties; Hardness of water. • Method of removal of hardness: 2 methods for each temporary & permanent.
2.5. Sulphur	**Hrs. Theory 5**
Objectives	Contents
1. To explain preparation and properties of Hydrogen Sulphide. 2. To explain chemistry of $SO_2$and H_2SO_4	• Laboratory preparation of Hydrogen Sulphide. • Uses of H_2S as analytical agent. • Manufacture of Sulphuric acid by contact process • Sulphuric acid as acid, precipitating agent, dehydrating agent & oxidizing agent • Use of SO_2as bleaching agent.
2.6. Nitrogen	**Hrs. Theory 4**
Objectives	Contents
1. To study chemistry of ammonia. 2. To prepare nitric acid and study their properties.	• Ammonia & manufacture by Haber's process • Uses: to prepare explosive & fertilizer. • Nitric acid, principle to prepare from ammonia, action with metals & uses
2.7. Oxygen	**Hrs. Theory 2**
Objectives	Contents
1. To explain types of oxides. 2. To study chemistry of Ozone.	• Types of Oxide (8 types) • Ozone: preparation, uses, advantages & disadvantages.
Group C	**Organic Chemistry : 35**
3.1. Introduction Of organic Chemistry	**Hrs. Theory 10**
Objectives	Contents
1. To know basic concept of organic chemistry. 2. To nomenclature organic compounds. 3. To define functional group and Homologous series.	• Vital Force Theory, rejection & modern definition of organic compounds • Catenation & tetravalency of C-atom, Foreign elements. • Lassaigne's extract method : principle • Chemistry of Lassaigne's method • Functional group & uses • Nomenclature system: introduction & 4 terms in IUPAC

	name. • Nomenclature of Hydrocarbons. • Nomenclature of Alcohol, aldehyde, acid, amide • Nomenclature of Ether, ketone & ester. • Homologous series & characteristics.
3.2. Isomerism	**Hrs. Theory 3**
Objectives	Contents
1. To define isomerism and their types.	• Definition of Isomerism, Structural isomerism • 4 types of isomerism • Examples of Isomerism
3.3. General reaction mechanism	**Hrs. Theory 3**
Objectives	Contents
1. To define cleavage of covalent bonds. 2. To explain reaction intermediates. 3. To differentiate electrophile and nucleophile.	• Homolytic & Heterolytic cleavage of Covalent bonds • Reaction intermediates: definition & stability of Carbocation, Carbanion & Free radicals. • Electrophile & Nucleophile
3.4. Hydrocarbons	**Hrs. Theory 14**
Objectives	Contents
1. To prepare alkane, alkene, alkyne and Benzene. 2. To study chemistry of alkane, alkene, alkyne and benzene. 3. To explain Aromaticity and orientation effects of benzene.	• Preparation of Alkane from: Wurtz reaction, Decarboxylation, Kolbe's electrolysis & Grignard reagent • Substitution reaction & Cracking of Alkanes. • Uses of alkanes • Preparation of alkenes from: Dehydrohalogenation, Dehydration & Hydrogenation • Addition of H_2, X_2, HX, H_2O to Alkene: Markovnikov's rule & peroxide effect • Ozonolysis of Alkenes. • Laboratory preparation of ethene & uses. • Preparation of alkynes from: C & H_2& 1, 2- dibromoethane • Addition of H_2, X_2, HX, H_2O & $O_3$to Alkyne. • Laboratory preparation of ethyne & uses • Huckel's rule of Aromaticity. • Preparation of Benzene from: acetylene, phenol, Chlorobenzene & benzoic acid. • Orientation effects of benzene. • Substitution reaction of Benzene.
3.5. Molecules of Life	**Hrs. Theory 5**
Objectives	Contents
1. To define different biomolecules. 2. To study importance of different biomolecules.	• Definition & Classification of Carbohydrates. • Proteins: Peptide Chain, Hydrolysis, Isoelectric point & Zwitter ions, Denaturation of Proteins, • Nucleic acid: types • Lipids: fats & oil, Rancidity & Hardening of lipids. • Importance of Biomolecules.

Group D	**Analytical Chemistry : 7**
4.1. Statistical methods in Chemical Analysis	**Hrs. Theory 7**
Objectives	Contents
1. To explain significant figures. 2. To explain different types errors. 3. To distinguish accuracy and precision. 4. To express different methods of accuracy and precision.	• Significant Figures: Significant digits • Errors in Chemical Analysis: Determinate & Indeterminate errors, Minimization of errors. • Distinction between Accuracy & Precision • Methods of expressing accuracy: absolute errors, relative errors & relative accuracy • Methods of expressing Precision: Standard deviation & Variance

Hrs. Lab.:39
14 experiments
- To study different chemical reactions. - To study about the types of flame in Bunsen burner. -To separate the mixture of Sand, Camphor & Common salt. -To separate the crystal of blue vitriol from its solution. -To carry out distillation to separate pure water from its impure form and also carried out test for acidic and basic impurities.
-To determine the equivalent weight of given weight of Magnesium metal by Hydrogen displacement method. -To determine the weight of given metal without weighing method by Hydrogen displacement method or oxide formation method.
-To determine $P^H$of different solutions by using universal indicator.
-To prepare Hydrogen gas and compare nascent Hydrogen and molecular Hydrogen.
-To prepare H_2S gas and study its properties as analytical agent.
-To prepare ammonia and study its properties. Also, carried out at least two test.
-To perform detection of foreign elements in the given organic compounds by sodium extract method. (at least 3 compounds)
-To perform unsaturation test to identify unsaturation in organic compound.(at least 3 saturated & 3 unsaturated compounds)

Biology I

Full Marks : 100

Total hours: 156
Theory: 117
Practical: 39

Botany I

Course Description:

This course aims at providing basic knowledge of Botany to certificate level students of Food and Dairy Technology. The course is divided into five units. The first unit gives introduction of Biology. The second unit provides information about molecules of living systems. The third unit provides information on cell and different cellular organelles and cell division as well. Unit four gives the concept of taxonomy, classification and biodiversity and it also provides information about organisms like bacteria, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. The fifth unit gives information about Virus.

Course Objectives:

After completing this course the students will be able to:

- Understand scope of Biology, its different branches, and interrelation of Biology with other sciences.
- Understand concept of taxonomy and biodiversity.
- Understand taxonomic terminologies to describe angiospermic plants.
- Explain the features of different groups of organisms-virus, bacteria, cyan bacteria, fungi, and all the groups of plants from algae to angiosperms.
- Know life cycles of some representative plants.
- Understand about cell and explain functions of various cell organelles

Minimum Standards: The students must achieve a minimum of 40% accuracy in theory and 50% accuracy in practical.

Recommended Textbooks:

A text book of Biology (part I and II)
Keshari, A. K. Ghimire, K. R., Mishra, B. S., and K. K. Adhikari, *A text Book of Higher Secondary Biology* Vidyarthi Pustak Bhandar, Kathmandu.
Modern approach botany - Bhatia
Ranjitkar, H. D. 2005. A Hand Book of Practical Botany. Mr. Arun K. Ranjitkar, Kalanki, Kathmandu.
Mahat, Ras Bihari, *A text book of Biology part I and Part II*

Course: Botany I	**58 hrs**
Unit 1: Introduction to Botany	**Theory: 4 hrs**
1.1 Nature and scope of biology	**Theory: 5 hrs**
Objectives	Contents
1. Define biology 2. List and define major branches of botany on the basis of field of study and plant groups. 3. Describe the interrelationship between different branches of Botany. 4. Discuss the relation of Biology with other sciences like Physics, Chemistry, Statistics, etc.	• Definition of Biology and Botany • Scope and importance of Biology • Different branches of Botany and their interrelationships • Relationship of Biology with other sciences
Evaluation: Oral and written tests, home assignments. **Types of questions:** Very short (1 mark) and Short (3 marks)	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, visuals, plant materials
Unit 2: Molecular Biology	**Theory: 10 hrs**
2.1 Life Components	**Theory: 1 hrs**
Objectives	**Contents**
Define the terms biomolecules, micro-molecules and macromolecules with examples and list inorganic and organic molecules of the living system. Define monomers and polymers with examples.	Definition of biomolecules, micro and macromolecules, inorganic and organic molecules and monomers and polymers with examples.
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, show items containing relevant biomolecules.
2.2 Water	**Theory:1 hrs**
Objectives	Contents
1. Give structure and properties of water. 2. List the biological role of water in living systems.	Structure, properties and biological role of water.
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.

2.3 Carbohydrates	**Theory:2 hrs**
Objectives	Contents
1. Define carbohydrates. 2. Define monosaccharide, oligosaccharides, and polysaccharides with examples. 3. List functions of carbohydrates.	Definition, types, examples, and biological role of Carbohydrates
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.
2.4 Proteins	**Theory: 2 hrs**
Objectives	Contents
1. Define proteins as polypeptides. 2. Define essential and non-essential amino acids with examples. 3. Define peptide bonds. 4. Define primary, secondary and tertiary structure of protein. 5. Define denaturation of or proteins. 6. List functions of proteins.	Definition, types, example and biological role of amino acids and proteins.
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.
2.5 Lipids	**Theory: 2 hrs**
1. Objectives 2. Define lipids as triglycerides. 3. Define saturated and unsaturated fatty acids. 4. Differentiate fats and oils. 5. List functions of Lipids.	Contents Definition, types, examples, and biological roles of Lipids.
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.
2.6 Nucleic acids	**Theory: 2 hrs**
Objectives	Contents
1. Define nucleic acids as polynucleotides. 2. List components of Nucleotides.	Definition, types, examples and biological roles of

3. Define and differentiate DNA and RNA (Watson and Cricks double stranded model picture of DNA) 4. List function of Nucleic acids.	Nucleic acids
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.
Unit: 3 Cell biology	**Hrs. 23 theory**
3.1 Introduction to cell	**Hrs. 12 theory**
Objectives	Contents
1. Explain that cell is a basic unit of life, Differentiate between plant cell and animal cell. 2. Differentiate between prokaryotic and eukaryotic cell.	• Ultra structure of different cell organelles and their functions: Cell wall, cell membrane, mitochondria, endoplasmic reticulum, glogi complex, lysosome , centrosome, vacuoles, Nucleus • Study about basic bacterial calls and its constituents.
Evaluation methods: oral and written tests, home assignments.	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
3.2 Cell division	**Hrs. 10 theory**
Objectives	Contents
1. Define cell cycle, amitosis, mitosis and meiosis. 2. Describe amitosis cell division. 3. Explain the significance of amitosis cell division. 4. Describe the steps of mitotic cell division using a labeled diagram. 5. Explain the significance of mitosis. 6. Describe the steps of meiotic cell division with necessary sketches. 7. Explain why meiosis is called reductional division and is important in sexually reproducing organisms. 8. Explain the significance of meiosis. 9. Distinguish between mitosis and meiosis.	• Definition of cell cycle. • Amitosis, mitosis and meiosis cell divisions. • Differences between mitosis and meiosis cell divisions.

Evaluation methods: oral and written tests, home assignments.	**Teaching learning activities and resources:** classroom instruction, discussion,textbook, and reference book self study.
Unit 4: Taxonomy and Biodiversity	**Theory: 18 hrs**
4.1: Concept of Taxonomy	**Theory: 2 hrs**
Objectives:	Contents:
1. Define taxonomy and classification 2. Define scope of taxonomy and its importance to other branches of biology. 3. Define binomial system of nomenclature. 4. Five kingdom classification system	• Definition, scope, interrelationship and importance of taxonomy. • Definition and methods of classification • Definition of Binomial nomenclature with rules. Whittakers five kingdom classification
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams.
4.2: Fungi	**Theory: 2 hrs**
Objectives	Contents
1. Define fungi. 2. Give general characteristics of fungi. 3. Outline the classification of fungi. 4. Describe life cycle of mucor and mushroom with labeled diagram. 5. Describe economic importance of Fungi.	• Definition, general characteristics and classification of fungi. • Life cycle of mucor and mushroom • Economic importance of fungi.
4.3: Algae	**Theory: 4 hrs**
Objectives	Contents
1. Define Algae. 2. List general characteristics of Algae. 3. Give three major classes of Algae- Chlorophyceae, Phaeophyceae and Rhodophyceae with their chief distinguishing features. 4. Describe structure, reproduction and life cycle of *Spirogyra* using labeled diagram. 5. Describe economic importance of Algae.	• Definition and general characteristics of Algae • Distinguishing features of major classes of Algae- Chlorophyceae, Phaeophyceae and Rhodophyceae • Structure, reproduction and life cycle of *Spirogyra* • Economic importance of Algae
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or materials:** Classroom instruction, textbooks, reference books, charts and diagrams or demonstration. Specimens of algae

4.4: Bryophyta	**Theory: 3hrs**
Objectives	Contents
1. Define Bryophyta. 2. Give general characteristics of Bryophyta. 3. Classify Bryophytes as liverworts, hornworts and mosses. 4. List economic importance of Bryophyta. 5. Give structure, reproduction and life cycle of *Marchantia.*	• Definition, general characteristics, and classification of Bryophyta as liverworts, hornworts and mosses • Economic importance of Bryophyta • Structure, reproduction and life cycle of *Marchantia*
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or materials :** Classroom instruction, textbooks, reference books, charts and diagrams. fresh or preserved plant materials
4.5: Pteridophyta	**Theory: 2 hrs**
Objectives	Contents
1. Define Pteridophyta. 2. Give general characteristics of Pteridophyta. 3. Describe life cycle of fern with well-labeled diagram. 4. Give economic importance of Pteridophytes.	• Definition and general characteristics of Pteridophyta • Description of life cycle of fern • Economic importance of Pteridophytes
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams. fresh plants or preserved specimens
4.6: Gymnosperms	**Theory: 2hrs**
Objectives	Contents
1. Define Gymnosperms. 2. Give general characteristics of Gymnosperms. 3. List major groups of living Gymnosperms with examples of representative species.	• Definition and general characteristics of Gymnosperms. • Major groups of living Gymnosperms and representative species of each group
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams. fresh plants or preserved specimens

4.7: Introduction to Angiosperms	**Theory: 1hrs**
Objectives	Contents
1. Define Angiosperms. 2. Give general characteristics of Angiosperms. 3. List differences between dicotyledons and monocotyledons.	• Definition and general characteristics of Angiosperms • Difference between dicots and monocots
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams
5: Virus	**Theory:3 hrs**
Objectives	**Contents**
1. Define virus and give general characteristics of virus. 2. Give classification of virus on the basis of host and genetic material. 3. Give structure of a Bacteriophase. 4. List some viral diseases in plants. 5. Describe the economic importance of virus.	• Definition, general characteristics, chemical composition, and classification of virus • Structure of Bacteriophase • Common viral diseases • Economic importance of virus
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams. Diseased plant parts can be shown in class.

Botany I : Practical

Course: Botany Practical	**Hours: 20**
Practical 1: Maintenance of laboratory	**Practical: 1hrs**
Objectives To study about various important parts of lab with their maintenance	**Contents** Lab maintenance
Practical 2: Plant Anatomy	**Practical: 3 hrs**
Objectives: 1. Describe the structure and functioning of a compound microscope. 2. Prepare temporary slides of onion peel	Contents: • Structure and functioning of a compound microscope • Preparation of temporary slides of onion peel

3. Prepare temporary slides of dorsiventral and isobilateral leaves to study the anatomical structures.	to study its anatomy. • Preparation of temporary slides of dorsiventral and isobilateral leaves to study the anatomical structures.
Practical 3: Taxonomy and Biodiversity	**Practical: 8 hrs**
Objectives **Monera:** 1. Study the different types of bacteria based on their morphology using permanent slides. 2. Study the filaments of *Nostoc* using compound microscope. **Fungi:** Study yeast cells and their budding under compound microscope. **Plantae:** 1. Study structure and conjugation in *Spirogyra* using compound microscope. 2. Study vegetative structure and stages of reproduction in *Marchantia* using fresh materials, preserved specimens and permanent slides. 3. Study the vegetative structure and reproductive stages of fern including herbarium specimen of sporophyte, slide of v. s. of leaf through sorus, and prothallus. 4. Study of the male and female cone of *Pinus.* **Taxonomy of Angiosperms:** Study different types of modification of root, stem and leaf.	**Contents** • Classification of bacteria on the basis of shape • Study of *Nostoc* under compound microscope • Study of yeast cells and their budding under compound microscope • Study of structure and conjugation in *Spirogyra* using compound microscope • Study of structure and reproduction of *Marchantia* using fresh or preserved materials and permanent slides • Study the structure and reproduction of fern using fresh or preserved materials and permanent slides • Study of male and female cones of *Pinus* **Taxonomy of Angiosperms:** • Study of some modifications of root, stem and leaf
Practical 4: cell biology	**Practical: 1 hrs**
Objectives: Study about different stages of cell division using permanent slides	Contents: Study of cell division.
Practical 5: Ecosystem	**Practical:2 hrs**
Objectives: 1. Define ecosystem 2. Name/List/Give the abiotic and biotic factors	Contents: • Abiotic factors of a pond. • Biotic factors of pond.

of an ecosystem 3. Define aquarium 4. Draw the well labeled diagram to show the food chain in ecosystem.	• Aquarium as a pond ecosystem.
Practical 6: herbarium	**Practical: 1 hrs**
Objectives: Prepare herbarium and preserve it.	Contents: Visit nearby botanical garden to collect different herbs and maintain herbarium.
Practical 7: General study of the plant kingdom	**Practical: 4 hrs**
Objectives	Contents
1. Study the given slides, specimens 2. Draw diagramestic of given specimens 3. Write down the characters of given specimens slides classify the specimens	Museum specimen studies.

Zoology I

Course Description

This basic course in zoology discusses the characteristics of unicellular and multicellular structures .The course contains introductory animal diversity, and the relationships between organisms and environment, the study of different types of tissues and a detailed study of the anatomy and physiology of mammals.

Practical zoology includes the study of microscope, study of museum specimens, preparation of temporary slides, dissection of earthworm.

Course objectives

After completing this course the students will be able to:

- Explain classification of animals and their basic characters.
- Explain different ecosystems.
- Describe different biogeochemical cycles and consequences of ecological imbalance
- Describe economic importance of some insects

Minimum standards

Students must achieve a minimum of 40% accuracy in theory, 60% accuracy in lab.

Recommended Text Books:

A text Book of Biologicy Part II - Aggrawal, S.
Modern Text Book of Zoology, Invertebrates - Kotpal, R. L.
Modern Text Book of Zoology, Vertebrates - Kotpal R. L.
A Textbook of Higher Secondary Biology, Vol I & Vol II - Arvind K. Keshari, Ghimire, Mishra & Adhikari
Practical Zoology (Invertebrate) - P. S. Verma

Zoology I 59 Hrs

Unit : 1 Animal phylogeny and classification	**Hrs.14 theory**
1.1 General characteristics and classification of different phyla of animals.	**Hrs. 14 theory**
Objectives	Contents
1. List the general characters of the phyla (Protozoa, Porifera, Coelentereta, Platyhelminthes, Aschelminthes, Annelida ,Arthropoda, Mollusca, Echinodermata and Chordata). 2. Give the classes of every phylum and two examples of each.	General characters of phylum Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Chordata.

Unit 2: Study of Earthworm	**Hrs. 8 theory**
Objectives	Contents
1. Give the systematic position, habit and habitat of earthworm. 2. Describe the morphology of earthworm with sketch. 3. Define digestion and describe the digestive system of earthworm. 4. List the organs involved in the digestive system. 5. Describe the physiology of digestion in earthworm. 6. Define the reproduction and describe the reproductive systems of earthworm. 7. Describe the male reproductive organs and female reproductive organs of earthworm. 8. Give the economic value of earthworm.	• Systematic position, habit, habitat, external, features, digestive system, reproductive system • Economic importance of earthworm.
Unit 3: Study of Paramecium	**Hrs. 4 theory**
Objectives	Contents
Give the systematic position, habit and habitat of paramecium. Describe the reproduction in Paramecium	Systematic position, habit, habitat, external, features, reproduction.
Unit 4: Ecology and environment	**Hrs. 25 theory**
Unit 4.1: Ecosystem	**Hrs. 12 theory**
Objectives	Contents
1. Define ecosystem and its types. 2. Identify major types of ecosystem- aquatic and terrestrial ecosystems 3. List abiotic and biotic factors of different ecosystems. 4. Define food chain and trophic level. 5. Develop a diagrammatic representation of food chain. 6. Describe energy and energy relations in an ecosystem. 7. Detailed study of pond and grassland ecosystem	• Structural and functional organization of ecosystems. • Examples of ecosystems and their types. • Abiotic and biotic factors of ecosystem and their interrelationships. • Food chain, trophic level and energy flow in an ecosystem. • Pond and grassland ecosystem (various components and their interrelationship)
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.

4.2 Bio-geochemical cycles	**Hrs. 5 theory**
Objectives	Contents
1. Define Biogeochemical cycle. 2. Describe the Carbon cycle and Nitrogen cycle.	• Sources of carbon and nitrogen cycle. • The movement of these elements in different forms in between abiotic and biotic components of environment.
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbooks, and reference books self study.
4.3 Ecological imbalances and consequences	**Hrs. 8 theory**
Objectives	Contents
1. Explain the theory of the greenhouse effect. 2. List the cause of green house effect. 3. Write the consequences of the green house effect. 4. Discuss the significance of green house effect, and explain why many scientists believe it will create a global crisis. 5. Define the acid rain and its effects. 6. State the importance of the ozone layer for living organisms. 7. Describe how some scientists' believe the ozone layer is going to deplete. 8. Describe the consequences of the depletion of the ozone layer. 9. Preventive measures of these different consequences.	• Description of greenhouse effect, acid rain and depletion of the ozone layer (Definition, Causes, effects). • Description of global warming & its effects. • Preventive measures.
Unit 5: Animal adaptation	**Hrs.5 theory**
Objectives	Content
1. Define adaptation. 2. Define the aquatic and amphibian adaptation with examples. 3. Define the terrestrial adaptation. 4. List the different types of terrestrial adaptations along with examples.	• Meaning of adaptations • Explanation of the adaptational features and examples of aquatic and amphibian adaptation • Explanation of the adaptational features of terrestrial adaptation and its types along with examples (Volant and arboreal).
Unit 6: Study of some economically important insects.	**Hrs. 2 theory**
Objectives	Contents
1. Give the systematic position, habit, habitat, life	Systemic position, habit and habitat, life cycle and

cycle of Honey bee and Silk worm. 2. Economic importance of Honey bee, Silk worm 3. Characters of silk thread.	economic importance of Honeybee and Silkworm.

Zoology I : Practical

Course: Practical Zoology	**Hrs .lab 19**
practical 1: Use of the microscope	**Hrs. lab 2**
Objectives	*Contents*
Name different types of microscope and their parts. Handle a microscope properly. Draw a well labeled diagram of compound microscope	Microscope, types, functions of its different parts, observation techniques.
Practical 2: General study of the animal kingdom	**Hrs.14 lab**
Objectives	Contents
1. Study the given slides, specimens 2. Draw diagramestic of given specimens 3. Write down the characters of given specimens slides classify the specimens properly.	• Study of permanent slides: protozoa: *Amoeba, Paramecium* • Study of museum specimens: o Porifera-*Sycon* o Coelenterata-*Hydra* o Platyhelminthes-Tapeworm, liver fluke o Aschelminthes-*Ascaris* o Annelida-Earthworm and leech o Arthropoda- Butterfly, Crab, Scorpion, Spider, Centipede, Prawn o Mollusca –*Pila* o Echinodermata-Starfish o Phylum:Chordata o Class: Pisces – *Labeo,Exocoetus* o Class: Amphibia-Frog,Toad o Class:Reptilia-wall lizard. o Class:Aves-Pigeon, Parrot. o Class: Mammals-Squirrel, Bat.
Practical 3: Dissection of earthworm	**3 hrs**
Objectives	Contents
1. Dissect the earthworm to observe the general anatomy, alimentary canal and reproductive system of earthworm. 2. Draw the well- labeled diagrams of the given systems and comment on them.	• Instruments used for dissection • Expose the general anatomy, alimentary canal, male reproductive system, female reproductive system

Second Semester

English-II

Total hours: 156 **Full Marks: 100**
Theory 156
Practical: 0

General objectives:

This course is designed with a view to provide students with techniques in the use of English for academic and communicative purposes, train them in the functional, notional and grammatical areas of English language uses, make them see the relationship between structure and meaning and teach them structures in a context. This course will to lead students from Intermediate to upper level of English proficiency and guiding them from general to comprehensive understanding of written tasks.

Unit 1: Core English-

The core English text for teaching language skills contains the following units:

Grammar and writing	Theory Hrs. (14X7 = 98)
Unit 9: Clarifying	**Theory Time hrs 14**
Objectives	Contents
1. Ask questions to get information 2. Make indirect questions 3. Form tag questions	• What kind of/ sort of/….? • What color/size/flavor…? • How..? Which…? Whose…? What…? How many…? How far….? • Do you know / Have you any idea/ Can you remember/ I wonder where he went? • Didn't he? • Wasn't he? • Wasn't it?
Unit 10: Wishes and regrets	**Theory Time hrs 14**
1. Make a wish or express dissatisfaction 2. Make sentences using second conditional structures 3. Express regret. 4. Write paragraph	• I wish/ If only + would… • I wish/ If only +I/We could • I wish/ If only +Past tense • If …..Past tense, I would/wouldn't +v1 • I wish/ If only +Past Perfect tense • I should (shouldn't) have done • If +Past Perfect…would(n't) have done • Could/needn't have done • Paragraph writing

Unit 11: Events in sequence	**Theory Time hrs 14**
Objectives	Contents
1. Narrate the events in sequence 2. Write the events in right(expected) and wrong order(unexpected) 3. Talk about an unexpected event following immediately on another. 4. Write stories	• As soon as/When +past simple • As soon as /When/After+ Past Perfect • He did X before he did Y • He didn't do Y until he had done X • He didn't do X before he did Y • He did Y before he'd done X • ….had only just…when • No sooner had….than… • Writing story
Unit 12: Comparison	**Theory Time hours 14**
Objectives	Contents
1. Compare the things to show the differences 2. Compare numerically using dimension nouns and adjectives 3. Make comparison with different tenses 4. Comprehend the passage	• Much/ a lot/ far more…than../ a little/ a bit/ slightly more..than../almost/ nearly as…as.. not quite/ not nearly as..as… • …..is about three times as expensive as…. • …..is about three times the price of …… • ……costs about three times as much as…… • ……..is about a third as expensive as/ the third of ….. • As +adjective+as • The +noun +of • The weather was worse last year than it <u>is</u> this year/ it should have <u>been</u>/ you said it would <u>be</u>/ I had expected it to <u>be</u> • Comprehension passage and writing basing on the paragraph
Unit 13: Processes	**Theory Time hrs 14**
Objectives	Contents
1. Connect two types of sequence 2. Emphasize the right order 3. Give instruction 4. Use the vocabularies 5. Write prospectus	• When +Present simple • When +Past perfect • You should do X before you do Y • You shouldn't do Y before/until you've done X • Vocabularies • Prospectus writing
Vocabulary: Natural process: melt, dissolve, evaporate freeze, condense, congeal	

Unit 14: Prediction	**Theory Time hrs 14**
Objectives	Contents
1. Express probability in prediction 2. Make sentences using conditional predictions- 3. If ,unless, As long as ,Provided	• He will certainly/definitely- is sure to • He will probably- is likely to • He probably won't- is unlikely to • He certainly/definitely won't • If / As long as/ Provided + he works hard' he will probably pass the exam • Unless he works hard he is unlikely to pass.
Unit 15: News	**Theory Time hrs 14**
Objectives	Contents
1. Make news of recent events 2. Make questions for finding out news 3. Indicate that the information is based on hearsay 4. Give second hand information	• Present perfect simple • Past simple and continuous • Present perfect Continuous • When/where/how did it happen? • Apparently/they say//I'm told + sentence • Be supposed to +infinitives • He is supposed to be poor • It is estimated/thought/believed/said that..
Unit 2: Extensive Reading and Writing	Theory Hrs. (8+21+21+8 = 58)
Objectives	
Interpret the prescribed texts related to different literary genres. Answer the questions based on the reading texts. Produce different types of free compositions.	
Contents	Objectives
Poems	Theory hrs. (2×4= 8)
	• Travelling Through the Dark, William Stafford. • God's Grandeur, Gerard Manley Hopkins
tory	Theory hrs. (3× 7 = 21)
	• The Tell-tale Heart, Edgar Allan Poe • Hansel & Gretel, Jacob & Wilhelm Grimm • The Boarding House, James Joyce.
Essays	Theory hrs (3× 7 = 21)
	• Women's Business, Ilene Kantrov • The Children Who Wait, Marsha Traugot. • A Child is Born, Germaine Greer.
Drama	Theory hrs (1×8 = 8)
	• Purgatory, W.B. Yeats.

नेपाली (Nepali)

Full Marks: 100

कक्षा भार : १५६ घण्टा
सैद्धान्तिक: ८ घण्टा/प्रति हप्ता
प्रयोगात्मक : ० घण्टा/प्रति हप्ता

पाठ्यांश परिचय :

यस पाठ्यांश अन्तर्गत विद्यार्थीहरूलाई ज्ञानविज्ञान, प्रविधि संचार, साहित्य आदि विविध विषय क्षेत्रका नेपाली भाषाका प्रयोगसंग परिचित गराउनका साथै विभिन्न भाषिक पृष्ठभूमि भएका विद्यार्थीहरूमा स्तरीय कथ्य र लेख्य नेपाली भाषाका दृष्टिले देखिन सक्ने त्रुटिहरूको निराकरण गर्ने र नेपाली भाषाका प्रयोगलाई शुद्ध एवं परिष्कृत तुल्याई व्यवहारिक र मौलिक अभिव्यक्तिको विकास गर्ने तर्फ जोड दिइनेछ । यिनै कुरालाई दृष्टिगत गरी यस पाठ्यांश मुख्यत: पठन र बोध, व्याकरण तथा त्यसको प्रयोगको अभ्यासका साथै लिखित अभिव्यक्ति र रचनाशिल्प सम्बन्धी पाठ्यवस्तुहरू समावेश गरिएका छन् ।

उद्देश्यहरू :

यो पाठ्यांश पूरा गरेपछि विद्यार्थीहरू निम्नलिखित कुरामा सक्षम हुनेछन :

क) स्तर अनुरुप विभिन्न क्षेत्रमा प्रयोग हुने कथ्य र लेख्य नेपाली भाषा सम्बन्धी बोध र अभिव्यक्ति क्षमता बढाउन,

ख) नेपाली भाषाका पुस्तक पत्रिका, लेख आदि सामग्री पढी स्तरीय भाषामा बुँदाटिपोट, संक्षेपीकरण, विवेचना र समीक्षा गर्ने क्षमता बृद्धि गर्न,

ग) व्यवहारिक सन्दर्भका अनुच्छेद, चिठी, सूचना, विज्ञापन, निबन्ध, टिप्पणी, प्रतिवेदन आदि प्रयोगमा देखिएका भाषिक त्रुटिहरूप्रति सचेत भई तिनको निराकरण तर्फ उत्मुख हुन,

घ) वर्णविन्यास, शब्दभण्डार, व्याकरण र वाक्यतत्व सम्बन्धी स्तरीय भाषामा भाव अभिव्यक्ति गर्ने सुझ प्राप्त गर्न,

विषय: नेपाली(Nepali)		घण्टा	नम्बर
खण्ड (क) नेपाली व्याकरण		२६	
एकाइ (अ) नेपाली वर्ण र वर्णविन्यास			
(क) नेपाली वर्णहरुको परिचय	(घ. १४)		५
(१) स्वरवर्ण: परिचय र वर्गीकरण			
(२) व्यञ्जनवर्ण: परिचय र वर्गीकरण			
(ख) नेपाली अक्षरहरुको संरचना	(घ. २)		
(ग) नेपाली वर्णविन्यास	(घ. १०)		५
(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		५
एकाइ (आ) शब्दवर्ग, शब्दरुपायन र शब्दनिर्माण (क) शब्दवर्ग (१) शब्दहरुको पहिचान र वर्गीकरण (स्रोत, बनोट र कार्यका आधारमा)(घ.३) (२) नाम, सर्वनाम, विशेषण र अव्यय (नामयोगी, क्रियायोगी, निपात, विस्मयादिवोधक, संयोजक) आदिको परिचय र वर्गीकरण (घ. ६) (ख) शब्दरुपायन (१) नाम, सर्वनाम, विशेषणको रुपायन (लिङ्ग, वचन र आदरका आधारमा) (घ. २) (२) क्रियापदको रुपायन (लिङ्ग, वचन, पुरुष, काल, पक्ष, भाव, वाच्यादिका आधारमा) (घ. २) (ग) शब्दनिर्माण (१) व्युत्पादन र रुपायन (घ. २) (२) उपसर्गहरुद्वारा शब्दनिर्माण (घ. ४) ▪ उपसर्ग र आधारतत्व ▪ अ, अन, कु, बे, वि, वद, प्र,अप, सम्, अनु, अधि, अति, उत्, प्रति, परि (३) प्रत्ययहरुद्वारा शब्दनिर्माण (घ. ४) ▪ धातु र प्रत्यय छुट्चाउने अभ्यास ▪ कृत्प्रत्यय र तद्धितप्रत्यय (४) कृत्प्रक्रियाद्वारा शब्दनिर्माण (घ. २) ▪ नु, आइ, ओट, आवट, अत, आहा, अक्कड, अन्त, उवा ▪ तव्य, य, अनीय (५) तद्धितप्रक्रियाद्वारा शब्दनिर्माण (घ. २) ▪ आलु, आहा, इया, इयार, इलो, औली ▪ य, ईय, क, ता, मान्, वान्, इक, तव्यः	३८	५ ५ ५ ५

(६) समासद्वारा शब्दनिर्माण (घ. ८) ▪ समासः परिचय र वर्गीकरण (तत्पुरुष, कर्मधारय, अव्ययीभाव, बहुब्रीहि, द्विगु, द्वन्द्व) ▪ समास र विग्रहको अभ्यास (७) द्वित्वप्रक्रियाद्वारा शब्दनिर्माण (घ. ३) ▪ द्वित्वप्रक्रिया : परिचय र अभ्यास ▪ पूर्ण, आंशिक र अपरिवर्तित द्वित्व		५
एकाइ (इ) वाक्यतत्व र वाक्यान्तरण (क) क्रिया : पहिचान र प्रकार (घ. ३) (ख) काल : पहिचान र प्रकार (घ. ४) (ग) पक्ष : पहिचान, प्रकार तथा काल र पक्षमा फरक (घ. १) (घ) भाव : पहिचान र प्रकार (घ. १) (ङ) वाच्य : पहिचान र प्रकार (घ. २) (च) पदसङ्गति : पहिचान र अभ्यास (घ. १) (छ) कारक र विभक्ति : पहिचान र प्रयोग (घ. २) (ज) वाक्यान्तरण : पहिचान र प्रक्रिया (घ. २) (झ) वाक्यसंलेषण : प्रक्रिया र अभ्यास (घ. २) (ञ) वाक्य विश्लेषण : प्रक्रिया र अभ्यास (घ. २) (ट) उक्ति परिवर्तन : प्रक्रिया र अभ्यास (घ. २)	२२	५ ५
खण्ड (ख) बोध र अभिव्यक्ति : (१) बोध : परिचय, शैली र अभ्यास (घ. ३) (२) बुँदा टिपोट : प्रक्रियागत अभ्यास (घ. २) (३) संक्षेपीकरण : प्रक्रियागत अभ्यास (घ. २) (४) अनुच्छेद लेखन : प्रक्रियागत अभ्यास (घ. ४) (५) पत्र लेखन : प्रक्रिया र प्रकार (घ. ५) (६) निबन्धरचना : परिचय, रचनाविधि र अभ्यास (घ. ४)	२०	१२
(७) कृति समीक्षा (क) निम्न कृतिहरुको सामान्य समीक्षाको अभ्यास	५०	

(१) कविता–	(घ. १५)		५
• लेखनाथ पौडचाल : नैतिक दृष्टान्त			
• लक्ष्मीप्रसाद देवकोटा : वन			
• गोपालप्रसाद रिमाल : परिवर्तन			
• बालकृष्ण सम : म पनि द्यौता मान्छु			
(२) कथा–	(घ. १५)		
• गुरुप्रसाद मैनाली : नासो			५
• विश्वेश्वरप्रसाद कोइराला : सिपाही			
• इन्द्र कहादुर राई : रातभरि हुरी चल्यो			
• रमेश विकल : मधुमालतीको कथा			
(३) निबन्ध–	(घ. १२)		५
• लक्ष्मीप्रसाद देवकोटा : वीरहरु			
• भैरव अर्याल : जयभूँडी			
• श्याम प्रसाद : आइमाई साथी			
(४) उपन्यास : लीलबहादुर क्षत्री : बसाइँ	(घ. ८)		५

सन्दर्भसामग्री

- नेपाली बृहत् शब्दकोश, नेपाल प्रज्ञा-प्रतिष्ठान, कमलादी काठमाडौँ, २०६५ ।
- भैरव अर्याल, भैरव अर्यालका हास्यव्यङ्ग्य, भैरव पुरस्कार गुठी, जोरपाटी, काठमाडौँ, २०६५ ।
- गुरुप्रसाद मैनाली, नासो कथा सङ्ग्रह, सम्पा. ताना शर्मा, प्रकाशक भारती मैनाली, बालाजु, काठमाडौँ, २०४९ ।
- मोहनराज शर्मा, शब्द रचना र वर्ण विन्यास, वाक्य तत्व, अभिव्यक्ति र साहित्य, काठामाडौं बुक सेन्टर, भोटाहिटी, काठमाडौँ, २०६६ ।
- लीलबहादुर क्षत्री, बसाइँ उपन्यास, साझा प्रकाशन, ललीतपुर ।

Physics-II

Total hours: 117 **Full Marks: 100**
Theory 156
Practical: 39

Light

Unit: 1 Light	**Hrs theory 35**
1.1 Reflection of light	**Hrs theory 8**
Objectives	**Content**
i. Explain the laws of reflection of light. ii. Distinguish between real and virtual image. iii. Show that in a plane mirror object distance = image distance. iv. Define the terms pole, center of curvature, radius of curvature, principal focus, principal axis, focal length. v. Show that R = 2f for spherical mirrors. vi. Draw ray diagrams to solve problems involving spherical mirrors. vii. Derive the formula 1/u+1/v= 1/f	• The Phenomenon of reflection and hence state the laws of reflection of light.Regular and irregular reflection of light • Object distance is just equal to image distance i. e.u=v but the image is virtual • Real and virtual image. • Sign convention for the focal length, object distance and image distance. • The relation R=2f, 1/u+1/v=1/f and • Magnification (m) = I/O= v/u for mirrors. • Nature, size and position of the image formed by spherical mirrors at various positions of the object distance on the principal axis. • Simple numerical problems
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Refraction	
1.2: Refraction	**Hrs theory 15**
Objectives	**Contents**
i. State and explain the laws of refraction of light. ii. Verify the laws of refraction of light and define refractive index of different media. iii. Derive the expression for apparent depth and lateral shift in a glass slab. iv. Define critical angle and total internal reflection. v. Explain the phenomena of total internal reflection. vi. Explain the passage of light rays through a prism.	• Phenomenon of refraction. • Refractive index in terms of the speed of light in vacuum to the speed of light in medium. • The relations $_a\mu^g x_g\mu^a=1$. • Refractive index in terms of real depth and apparent depth. • Derivation of the formula$\mu=1/Sinc$. • ,Critical angle and conditions for total internal reflection. • Examples of total internal reflection phenomena like mirage, light pipe.

vii. Define minimum deviation and derive the formula $\mu=\sin(A+\delta_m)/2/\sin(A/2)$. viii. Draw a ray diagram to locate positions of image in thin lenses (concave and convex). ix. Lens formula and lens maker's formula (No derivation).	• The formula $\mu= \sin (A+\delta_m/2/\sin A/2$. • Uses of different types lens. • Converging aspect of convex lens and diverging aspect of concave lens. • Lens formula and lens maker's formula(No derivation). • Simple numerical problem
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Optical Instrument	
1.3: Optical Instrument	**Hrs theory 7**
Objectives	**Contents**
i. Explain defects of vision- Myopia and Hypermetropia. ii. Define angular magnification of telescope. iii. Define astronomical telescope in normal adjustment. iv. Simple microscope- Ray diagram and formula for magnification. v. Compound microscope – Ray diagram and formula for magnification. vi. Define dispersion of light. vii. Define luminous flux, luminous intensity and illuminance, lumen, lux and candela. viii. State inverse square law of photometry. ix. Solve related numerical problem.	• Explain defects of vision- Myopia and Hypermetropia. • Definition of angular magnification of telescope. • Definition of astronomical telescope in normal adjustment. • Simple microscope- Ray diagram and formula for magnification. • Compound microscope – Ray diagram and formula for magnification. • Explanation of dispersion of light. • Definition of luminous flux, luminous intensity and illuminance, lumen, lux and candela. • Statement of inverse square law of photometry. • Solve related numerical problem.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
Wave theory of light	
1.4: Wave theory of light	**Hrs theory 5**
Objectives	**Contents**
i. Explain wave front and wavelets. ii. State Huygen's principle. iii. Define coherent sources, interference, constructive interference and destructive interference.Youngs double slit experiment. iv. Define diffraction of light. v. Show formation of interference and diffraction fringes by diagram. vi. Define Polarisation of light.	• Explanation of wave front and wavelets. • Statement of Huygen's principle. • Definition of coherent sources and interference. Condition for interference. • Definition of constructive and destructive interference. • Definition of diffraction of light. • Show formation of interference and diffraction fringes by diagram. • Explanation of Polarisation of light.Plane polarise and circularly polarise, plane of polarization, plane of vibration.

Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Wave	
Unit 2. Wave	**Hrs theory 12**
2.1: Wave motion	**Hrs theory 12**
Objectives	**Contents**
a) Define damped vibration, forced vibration and resonance. b) Define longitudinal wave, progressive wave and stationary wave. c) State progressive wave equation and stationary wave equation. d) Explain velocity of sound in medium and gas by Newton's formula & Laplace formula (no derivation). e) Effect of temperature, pressure & humidity on velocity of sound. f) Define harmonics and overtones. g) Concept of fundamental frequency and harmonics in organ pipes. h) State laws of transverse vibration of string.	• Definition of damped vibration, forced vibration and resonance. • Definition of longitudinal wave, progressive wave and stationary wave. • State progressive wave equation and stationary wave equation. • Explanation of velocity of sound in medium and gas by Newton's formula & Laplace formula (no derivation). • Effect of temperature, pressure & humidity on velocity of sound. • Definition of harmonics and overtones. • Concept of fundamental frequency and harmonics in organ pipes. • Statement of laws of transverse vibration of string. • Solve related numerical problems
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Current electricity	
Unit 3: Current electricity	**Hrs theory 30**
3.1: Electric current	**Hrs theory 8**
Objectives	**Contents**
a) Discuss current as the rate of flow of charge. b) State and verify Ohm's law. c) Define resistance and resistivity d) List the factors that influence resistance of a conductor. e) Distinguish between ohmic and non-Ohmic conductors. f) Find the equivalent resistance from the series and parallel combination of resistors. g) Perform the conversion of galvanometer into voltmeter and ammeter	• Current as the rate of flow charge • Potential deference • Ohm's law and its verification • Expression $R=R_1+R_2+R_3+$.....and $1/R=1/R_1+1/R_2+1/R_3+$..... in series and parallel combination. • Conversion of a galvanometer into ammeter and voltmeter. • Ohmic and non-Ohmic conductors from I-V curve. • Conversion of galvanometer into voltmeter and ammeter. • Simple numerical problems.

Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Resistance and heat	
3.2: Resistance and heat	**Hrs theory 6**
Objectives	**Contents**
a) State and explain joule's laws of heating. b) Distinguish between potential difference and *emf*. c) Relate *emf*, terminal potential and internal resistance. d) Krichhoffs law. Wheatstone bridge principle	• Joule's laws of heating and derivation of the equation $H=i^2Rt/J$. • Heat production in resistance wire due to passage of current. • Electric power in terms of energy dissipated in a time in the resistance wire. • Meaning of *emf*and internal resistance *ofa* cell relation E=V+Ir • Electric power, watt, kilowatt, kilowatt-hour and horsepower. • Simple numerical problems
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Electromagnetism	
3.3: Electromagnetism	**Hrs theory 9**
Objectives	**Contents**
a) Explain Oersted's discovery, direction of current and field. b) Dependence of force on physical factors. c) Find force on moving charge. d) State the principle of moving coil galvanometer. e) Define electromagnetic induction.. f) State Faraday's laws of electromagnetic induction. g) State Lenz's law.	• Explanation of Oersted's discovery, direction of current and field. • Dependence of force on physical factors. • Find force on moving charge. • Statement of principle of moving coil galvanometer. • Definition of electromagnetic induction.. • Statement of Faraday's laws of electromagnetic induction. • Statement of Lenz's law. • Solve related numerical problems.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
Alternating current	
3.4: Alternating current	**Hrs theory 7**
Objectives	**Contents**
a) Describe alternating current (AC) and its interpretation. b) Relate *rms* and mean value of current and	• AC and DC importance of AC over DC. • Expression i_{rms}, v_{rms} and i_{mean}, v_{mean} with peak

voltage with its peak value. c) Appreciate that ac meters measures *rms* values only. d) Describe step up and step down transformers. e) State faraday's laws of electromagnetic induction.	value. • Faraday's law of electromagnetic induction
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:**classroom instruction and demonstration, return demonstration models, solving related problems

Modern physics	
Unit 4: Modern physics	**Hrs theory 40**
4.1: Electrons	**Hrs theory 6**
Objectives	**Contents**
a) Explain the practical nature of electricity. b) Discuss the nature, production and properties of cathode rays c) Review the motion of electrons in electric and magnetic fields.	• Partical nature of electricity • Production and properties of cathode rays • Moving electrons in electric and magnetic fields. • Specific charge of an electron.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Photo electricity	
4.2: Photo electricity	**Hrs theory 8**
Objectives	**Contents**
a) Define the terms photoelectric effect, photon, wave function, threshold frequency and stopping potential. b) Explain photoelectric effect on the basis of the quantum theory of radiation. c) Draw a photoelectric equation. Give the application of photoelectric effect d) State postulates of Bohr's theory of hydrogen atom.	• Photoelectric effect, quantum theory of radiation. • Einstein's photoelectric equation • $hv=\varphi+1/2mv^2$ and interpretation. • Simple problems using photoelectric equations. • Explanation of postulates of Bohr's theory of hydrogen atom.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

X-Ray	
4.3 X-ray	**Hrs theory 4**
Objectives	**Contents**
a) Draw well leveled diagram of modern x-ray tube. b) Explain the production mechanism of x-rays.	• Production and nature of x-rays. • Properties of x-rays.

c) Discuss the properties of x-rays.	• Various uses of x-rays.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
Radioactivity	
4.4: Radioactivity	**Hrs theory 10**
Objectives	**Contents**
a) Explain the difference between natural and artificial radioactivity b) List the main properties of α, β and γ radiation. c) Explain why these forms of radiation have energy on the order of mega electron voltage. d) Write down the equation for the laws of radioactivity e) Write down the formula that shows that the relationship n between half-life and decay constant. f) Graph the decay of radioactivity with time. g) Explain the principle involved in radio carbon dating.	• Radioactivity. • Properties of α, β and γ radiations. • Laws of radioactive disintegration. • The constant relationship between half-life and decay. • Medical uses of radiation and artificial radioactive nuclei. • $N=N_o e^{-\lambda t}$, $dN/dt = -\lambda t$ • Simple numerical problems.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Properties of nucleus	
4.5: Properties of nucleus	**Hrs theory 6**
Objectives	**Contents**
a) Describe the constituents of a nucleus. b) Classify different types of nuclei. c) Define unified atomic mass units (amu), mass defect, binding energy and binding energy per nucleons, d) Calculate the mass defect and binding energy of a nucleus e) Calculate energy equivalence of mass in joules, eVand MeV f) Explain Einstein's mass-energy relationship theory. g) Define fission and fusion and calculate the energy released h) Discuss health hazards and safety related to radiation.	• The constitutions of nuclei. • Isotopes and mass numbers of different elements • $E=mc^2$ (only qualitatively) • Fission, fusion, and energy released from these nuclear reactions • Radiation hazard and safety. • Calculation of mass, defect and loss of mass due to radioactive disintegration numerically.
Physics and society	
4.6: Physics and society	**Hrs theory 6**
Objectives	**Contents**
a) Describe how our environment is being destroyed due to noise pollution, air pollution, soil pollution, thermal pollution,	• Deteriorating conditions of the environment we live in.

radiation pollution and water pollution b) Discuss the wide spectrum of electromagnetic radiation form radio waves to cosmic rays. c) Discuss ozone depletion, greenhouse effect, and acid rain. d) Discuss strategies to reduce pollution at local and national levels.	• Useful and harmful aspects of radiation. • Concepts about ozone depletion, greenhouse effect and acid rain. • Concepts of different types of pollution. • Environmental protection strategies.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems

Physics practical

Diploma: 2nd sem.

Course: Physics practical **Hrs: 39**

Objectives		Lab Hour
1	Verify the laws of reflection and refraction	8
2	Verify ohms law by using an ammeter and voltmeter.	5
3	Determine the resistance of given wire using Wheatstone's bridge principle.	5
4	Determine the focal length of convex lens by using plane mirror method.	5
5	Determine the focal length of convex lens by using u-v method.	4
6	Determine the refractive index of prism.	4
7	Compare the emf of two cells using potentiometer.	4
8	Verify the law of series and parallel resistance using meter bridge.	4

Chemistry-II

Credit hours: 6 + 2 hours/week
Total hours: 156 **Full Marks: 100**
Theory 117
Practical: 39

Course Description:

This course is designed to give students the fundamental concept of physical, organic and in-organic chemistry. Emphasis is given to the principles related to chemistry within everyday life and to the application of chemistry in Food science. An additional function of the course is to stimulate interest in the application of chemistry and to prepare the student or further study in this field. Chemistry practical acquaints the student with the use of related laboratory equipment and provides practical application of learned theory, which is relevant to Food technology.

Course Objectives: Upon completion of the course, students will be able to:

- Explain the basis chemical changes involved in Chemistry.
- Test the food to make food for edible.
- Apply the knowledge of chemistry for the production of improved quality & hygienic food.
- Utilize chemical principles in laboratory testing.
- Prepare standard chemical & carry out chemical analysis related to food & dairy technology.
- To know separation techniques and Chromatographic analysis.

Minimum Standards: Students must achieve a minimum of 60% accuracy in practical, 40% accuracy in theory.

Recommended Texts/ Reference Texts:

8. Foundations of Chemistry (Part II) – Taleju Prakashan
9. Elementary Chemical Calculation - Taleju Prakashan
10. Elementary Practical Chemistry – M.K. Sthapit
11. Elementary Qualitative Analysis – Taleju Prakashan
12. Modern Inorganic Chemistry – R.D. Madan
13. Organic Chemistry, 6th edition -R. T.Morrison and R.N. Boyd
14. Essential of Physical Chemistry – B.S. Bahl
15. Advanced Physical Chemistry – Gurdeep Raj
16. A textbook of Physical Chemistry – A.S. Negi and S.C. Anand

Course: Chemistry – II	**Hrs. Theory:**117
Group A	**Physical Chemistry: 40**
1.1. Ionic equilibrium	**Hrs. Theory 6**
Objectives	Contents
1. To express different ways of concentration of solution. 2. To derive dilution law. 3. To determine pH of electrolytes. 4. To explain common ion effect and solubility product principle	• 7 Ways of expressing concentration of Solution: Normality, Molarity, Percentage, Gram per liter, Molality, Mole fraction & Part per million. • Ostwald's Dilution Law: Degree of ionization & ionization constant. • Ionization of water • Calculation of P^H of Weak and Strong electrolytes. • Common ion effect & Solubility product principle, applications. • Numerical Problems
1.2. States of Matter(gas)	**Hrs. Theory 6**
Objectives	Contents
1. To state different gaseous laws. 2. To state postulates of Kinetic theory of gases.	• Boyle's Law / Charle's Law / Combined gas law / Dalton's Law / Graham's Law: Statement, explanations &applications/ Kinetic theory of Gases • Numerical Problems
1.3. Electrochemistry	**Hrs. Theory 6**
Objectives	Contents
1. To differentiate between electrolytic and electrochemical cells. 2. To explain origin of electrode potential. 3. To explain electrochemical series and their applications. 4. To derive Nernst's equation and cell potential.	• Difference between Electrolytic cell & Electrochemical cell, Salt Bridge & its Function. • Origin of electrode potential & standard electrode potential • Reference electrodes: Standard Hydrogen Electrode, Calomel electrode & applications • Electrochemical series & 5 applications. • Nernst's equation for electrode & cell potential. • Numerical Problems for emf of cell
1.4. Theory on Chemical Bonding	**Hrs. Theory 5**
Objectives	Contents
1. To explain formation of covalent bonds. 2. To define Hybridization. 3. To explain VSEPR theory.	• Concept of sigma & pi bond • Hybridization & its 3 types • Prediction of geometry on the basis of hybridization. • VSEPR theory • Applications of VSEPR Theory
1.5. Chemical Kinetics	**Hrs. Theory 6**
Objectives	Contents
1. To define order and molecularity of reaction. 2. To explain factors affecting rate of reaction and rate law equation.	• Concept of rate of reaction: average & instantaneous rate of reaction. • Stoichiometry & rate of reaction • Factors affecting rate of reaction • Rate law equation & rate constants & units

3. To state collision theory.	• Order of reaction & molecularity of reaction: types & examples. • Collision theory of reaction rates
1.6. Titrimetric analysis	**Hrs. Theory 6**
Objectives	Contents
1. To define standard solution and requisities of standard substances. 2. To define titration and use of indicators. 3. To draw different types of PH curves.	• Standard Solution, Primary standard substances & it's requisities, secondary standard solution • Titration: Acid-base & redox titration • End point & equivalence point, Use of indicator • P^H curves for acid-base titrations • Numerical related to normality equation **2 Lect**
1.7. Thermochemistry	**Hrs. Theory 5**
Objectives	Contents
1. To define different thermodynamic terms. 2. To explain first and second laws of thermodynamics. 3. To explain spontaneity of reaction.	• Thermodynamic terms: System & its type, Surroundings, Boundary, Universe, State variables, intensive & extensive properties, State & path functions. • 1^{st} Law of thermodynamics, limitation • 2^{nd} law of thermodynamics & Concept of Entropy. • Gibb's free energy & Gibb's – Helmholtz reaction, free energy & work. • Spontaneity of reaction
Group B	**Inorganic Chemistry 32**
2.1. Atomic Structure	**Hrs. Theory 6**
Objectives	Contents
1. To define orbitals. 2. To write quantum numbers. 3. To explain theories on electronic configuration.	• Concept of Orbitals & degenerate orbitals • Quantum Number & its types. • Some examples. • Aufbau principle & Limitation, electronic configuration in orbitals. • Pauli's Exclusion Principle& Hund's rule. • Block notation electronic configuration of top 30 elements
2.2. Metals & Metallurgical Principles	**Hrs. Theory 7**
Objectives	Contents
1. To define ores, minerals, alloys and metallurgical steps. 2. To explain different metallurgical steps.	• Ores & Minerals, alloy & its types, uses, amalgam & uses, • Metallurgy: 3 types. • General Metallurgical steps: Flow chart/ • 4 ways of Concentration: Gravity separation, Froth-floatation process, magnetic separation process & leaching • Calcination or Roasting • 3 ways of reduction: Smelting/ Aluminothermite & Electrolytic • 4 ways of refining : Liquation, Polling, Distillation & electrolytic

2.3. Alkali & Alkaline earth Metals	**Hrs. Theory 6**
Objectives	Contents
1. To explain similarities and differences between alkali and alkaline earth metals. 2. To explain chemistry of caustic soda, washing soda, quick lime, beaching powder etc.	• Similarities & Differences between Alkali metal & Alkaline earth metals. • Sodium, Physical & Chemical Properties, biological importance. • Sodium Hydroxide, Chemical Properties, uses. • Washing & Baking Soda, physical & chemical Properties. • Chemistry of Quick Lime & Bleaching Powder • Chemistry of Magnesia, uses of Na, K, Ca & Mg
2.4. Heavy Metals	**Hrs. Theory 7**
Objectives	Contents
1. To explain characteristics of transition metals. 2. To study chemistry of Cu, Fe, Zn, Ag and Hg. 3. To study chemistry of Blue vitriol, Green Vitriol, White Vitriol, Philosopher's wool, Calomel, Corrosive Sublimate etc.	• Typical & Non-typical transition elements, Characteristics of heavy metals/ Coinage metals. • Occurrence of Cu, properties, preparation & uses of Blue vitriol, red Oxide & black oxide. • Properties & uses of Iron, Green Vitriol, Mohr's Salt & $FeCl_3$. • Properties & uses of Zinc, Philosopher's wool & white vitriol. • Properties & uses of mercury, Calomel & Corrosive Sublimate / Mercury Poisoning. • Properties & uses of Silver, Lunar Caustic & Horn Silver. • (no extraction of Metals, only physical & chemical properties)
2.5. Environmental Pollution	**Hrs. Theory 6**
Objectives	Contents
1. To study air pollution and water pollution and their effects. 2. To explain Ozone hole, smog. 3. To define Global warming, acid rain and chemical pollution.	• Air Pollution in the Troposphere: pollutants, source & harmful effects. • Pollution on the Stratosphere: Depletion of Ozone layer & formation of Ozone hole. • Smog (London & Los Angeles smog) • Acid rain, Global warming & Greenhouse effect. • Water Pollution: OD, BOD & COD. • Chemical Pollution & its Control.
Group C	**Organic Chemistry 35**
3.1. Haloalkanes	**Hrs. Theory 7**
Objectives	Contents
1. To Classify and nomenclature of Haloalkanes. 2. To study preparation and properties of Haloalkanes. 3. To study chemistry of Chloroform.	• Nomenclature & Classification. • Preparation from Alkane, Alkene & Alcohol. • Physical properties of Haloalkane • 6 Nucleophilic substitution reaction • Reaction with Metal • Preparation of Chloroform (principle only), uses: Chloropicrin & Chloretone with reaction • Preparation of Chlorobenzene & substitution reaction, uses to prepare DDT

3.2. Alcohols	**Hrs. Theory 6**
Objectives	Contents
1. To Classify and nomenclature of Alcohols. 2. To study preparation and properties of Alcohols and Phenols. 3. To distinguish isomeric alcohols.	• Victor- Meyer methods to separate isomeric alcohols. • Preparation of alcohols from Grignard reagent • Oxidation & dehydration of alcohol • Test of alcohol: Iodoform test & Esterification test. • Fermentation of Alcohols • Preparation of Phenol from Benzene diazonium chloride, Uses to prepare azodye & Bakelite.
3.3. Carboxylic acids	**Hrs. Theory 6**
Objectives	Contents
1. To Classify and nomenclature of Carboxylic acids. 2. To study preparation and properties of Formic acid and Benzoic acid. 3. To explain constituent effects of acids.	• Principle for preparation of Formic acid • Abnormal behavior of Formic acid. • Acidic nature of Acids (6 reactions) • Preparation for 4 derivatives. • Constituents effect in acidity of acids. • Benzoic acid, preparation & uses
3.4. Aldehydes & Ketones	**Hrs. Theory 5**
Objectives	Contents
1. To Classify and nomenclature of Aldehydes and Ketones. 2. To study typical reactions of carbonyl compounds.	• Preparation from alcohol, acids & alkenes • Oxidation reactions • Some reactions: Aldol Condensation, Cannizaro reaction, Perkin's reaction & Benzoin condensation. • Reduction reaction: Clemmension, Wolff- Kishner reduction reactions. • Uses.
3.5. Nitro Compounds & Amines	**Hrs. Theory 6**
Objectives	Contents
1. To Classify and nomenclature of Aniline and Nitrobenzene. 2. To study preparation and properties of amines. 3. To study Nitrous acid test.	• Classification of amines, Hoffmann's method of separation of isomeric amines • Test of amines: Nitrous acid test. • Preparation of Aniline (principle only) & uses; • Some reaction: Hoffmann's decarbonylation reaction & Carbyl amine reaction. • Preparation of Nitrobenzene (principle only) & uses • Reduction of Nitrobenzene.
3.6. Chemistry in service to mankind	**Hrs. Theory 5**
Objectives	Contents
1. To study polymers, drugs, dyes, fertilizers and insecticides.	• Polymers: Classification, formation & uses. • Drugs: Classification & examples. • Dyes: Classification • Fertilizer: Classification • Insecticides: classification.

Group D	**Analytical Chemistry 10**
4.1. Separation Methods & Chromatography	**Hrs. Theory 10**
Objectives	Contents
1. To study different chromatographic techniques. 2. To study migration parameters. 3. To explain the different detectors used in GC.	• Chromatography: Paper Chromatography, Thin layer Chromatography, Gas Chromatography: Principle, Experimental & Applications **8 Lect** • Migration parameters • Detectors used in GC.

Hrs. Lab.:39
14 experiments
-To determine the strength of given alkali and base in terms of: Normality, Molarity, gram per liter and percentage. - To prepare semi-normal and decinormal solution of oxalic acid crystals. -To prepare 0.5 N, 0.1 N, 1 N and 2 N Hydrochloric acid solution.
-To standardize sodium carbonate solution with Sulphuric acid solution. -To standardize the given potassium permanganate solution, supplied with N/20 oxalic acid. -To standardize Mohr's salt with Potassium permanganate solution.
-To identify acid radicals present in given salt by dry and wet ways. (at least 3 samples) - To identify basic radicals present in given salt by dry and wet ways. (at least 3 samples) -To identify acid radicals and basic radicals present in given salt by dry and wet ways. (at least 1 samples)
-To distinguish (i) Ethanol and Ethanoic acid, (ii) Ethanol and methanol acid from given samples X and Y.
-To distinguish (i) Ethanal and propanone, (ii) Benzaldehyde and acetone from given samples X and Y.
-To distinguish Ethanamine and aniline from given samples X and Y.

Biology II

Full Marks: 100

Total hours: 156
Theory: 117
Practical: 39

Botany II

Course description

This course aims at providing basic knowledge of Botany to certificate level students of Food and Dairy Technology. It provides information on plant anatomy, physiology. It covers knowledge about membrane transport, transpiration, photosynthesis and respiration. This course also tells about different aspects of genetics. It also gives introduction to economic and ethno botany and also gives the account of biotechnology including tissue culture and genetic engineering.

Course Objectives:

After completing this course the students will be able to:

- Understand basic principles of genetics biotechnology and plant breeding.
- Understand basic anatomical features and physiological process in plants.
- Know identifying features with their economic importance.
- Identify some important medicinal plants of Nepal and their uses.
- Explain about ethnobotany and its importance.
- Understand basic knowledge of genetics

Minimum Standards:

The students must achieve a minimum of 40% accuracy in theory

Recommended Textbooks:

A text book of Biology (part I and II)

Keshari, A. K. Ghimire, K. R., Mishra, B. S., and K. K. Adhikari, *A text Book of Higher Secondary Biology* Vidyarthi Pustak Bhandar, Kathmandu.

Modern approach botany - Bhatia

Ranjitkar, H. D. 2005. A Hand Book of Practical Botany. Mr. Arun K. Ranjitkar, Kalanki, Kathmandu.

Mahat, Ras Bihari, *A text book of Biology part I and Part II*

Botany II 58 hrs

Unit 1:: Plant Anatomy	
1.1: Tissue and its types	**Theory: 8 hrs**
Objectives:	Contents
1. Define tissue 2. Classify tissues as Meristematic, Permanent and Secretory 3. List features of Meristematic tissues 4. Give types of Meristematic tissues with examples 5. Define permanent tissues 6. Classify permanent tissues as simple and complex 7. List basic features, distribution and function of different simple and complex permanent tissues 8. Define secretory tissues 9. Give types of secretary tissues, their examples and importance. 10. Define primary and secondary tissues. 11. List and define types of Xylem- protoxylem and metaxylem; exarch, endarch, mesarch and centrarch. 12. Define vascular bundles and their elements- xylem, phloem and cambium. 13. Identify types of vascular bundles- radial, conjoint (collateral, bicollateral and concentric); open and closed.	• Definition of tissue • Types of tissues- Meristematic, permanent and secretory • Features of Meristematic tissues. • Types and examples of Meristematic tissues- apical, intercalary and lateral; primary and secondary • Classification of permanent tissues as simple and complex • Basic features, distribution and function of different simple and complex permanent tissues • Definition of secretory tissues • Types of secretary tissues, their examples and importance. • Definition of primary and secondary tissues. • Types of Xylem- protoxylem and metaxylem; exarch, endarch, mesarch and centrarch. • Vascular bundles and its elements-xylem, phloem and cambium. • Types of vascular bundles- radial, conjoint (collateral, bicollateral and concentric); open and closed.
Unit 2: Plant Physiology	**Theory: 25 hrs**
2.1: Diffusion	**Theory: 4 hrs**
Objectives	Contents
1. Define diffusion and list its importance in living systems. 2. List the factors affecting diffusion.	• Definition of diffusion • Factors affecting diffusion. • Significance of diffusion, demonstration of diffusion.
Evaluation: Oral and written tests, home assignment. Types of questions: Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or Materials**: Classroom instruction, textbooks, reference books, charts, and diagrams, demonstration of diffusion.

2.2: Osmosis	**Theory: 7 hrs**
Objectives	Contents
1. Define osmosis and the terms related to osmosis- semipermeable, osmotic pressure, water potential, hypotonic and hypertonic solutions, endosmosis and exosmosis, plasmolysis and turgid and flaccid cells. 2. List the significance of osmosis. 3. Define active transport and give its significance. 4. Root pressure and ascent of sap	• Definition of Osmosis and related terms like, semipermeable, osmosis pressure, water potential, hypo- and hypertonic solution, endo- and exosmosis, plasmolysis, turgid and flaccid cells • Definition of active transport and its significance. • demonstration of osmosis • Root pressure and ascent of sap
Evaluation: 1. Oral and written tests, home assignment. 2. Types of questions: Very short (1 mark), Short (3 marks) and Long (7 marks).	Teaching Methods or Materials: Classroom instruction, textbooks, reference books, charts, and diagrams, demonstration of osmosis.
2.3: Transpiration	**Theory: 2 hrs**
Objectives	Contents
1. Define transpiration. 2. Define stomatal, lenticular and cuticular transpiration. 3. Describe factors affecting transpiration. 4. Describe the significance of transpiration.	• Definition of transpiration and its types. • Factors affecting transpiration. • Significance of transpiration. • demonstration of transpiration.
Evaluation: 1. Oral and written tests, home assignment. 2. Types of questions: Very short (1 mark), Short (3 marks) and Long (7 marks).	Teaching Methods or Materials: Classroom instruction, textbooks, reference books, charts, diagrams and demonstration of transpiration.
2.4: Photosynthesis	**Theory: 5 hrs**
Objectives	Contents
1. Define Photosynthesis. 2. List some major photosynthetic pigments and identify their role, structure of chloroplast. 3. Identify the sites of photosynthesis. 4. List the major steps of photosynthesis. 5. List the factors affecting photosynthesis.	• Definition of Photosynthesis. • Major photosynthetic pigments and their roles • Sites of Photosynthesis-grana and stroma of chloroplast • Major steps of photosynthesis- trapping of light, light reaction, photolysis of water, photophosphorylation and dark reaction (Calvin cycle) (detail steps and mechanism not required)

Evaluation: 1. Oral and written tests, home assignment. 2. Types of questions: Very short (1 mark) and Short (3 marks).	Teaching Methods or Materials: Classroom instruction, textbooks, reference books, charts, diagrams and demonstration.
2.5: Respiration	**Theory: 5 hrs**
Objectives	Contents
1. Define respiration. 2. Define and differentiate aerobic and anaerobic respiration. 3. Identify the sites of respiration. 4. List the major steps of aerobic respiration. 5. List the factors affecting aerobic respiration. 6. Give major steps of anaerobic respiration and fermentation.	• Definition of respiration. • Definition of aerobic and anaerobic respiration and their differences • Sites of respiration-cytoplasm and matrix and cristae of mitochondria • Major steps of aerobic respiration-glycolysis, link reaction, Krebs cycle and oxidative phosphorylation (details and mechanism not required) • Major steps of anaerobic respiration-the alcoholic pathway and the lactate pathway
Evaluation: 1. Oral and written tests, home assignment. 2. Types of questions: Very short (1 mark) and Short (3 marks).	Teaching Methods or Materials: Classroom instruction, textbooks, reference books, charts, diagrams and demonstration.
2.6 Plant hormones	**Theory: 2 hrs**
Objectives	Contents
1. Define plant hormone 2. Enlist plant hormones 3. Roles of plant hormones	Definition, roles of different plant hormones in development of plants.
Unit 3: Genetics	**Theory: 15 hrs**
3.1 Heredity and Variation	**Theory: 10 hrs**
Objectives	Contents
1. Define heredity and variation. 2. Explain causes of variation like environmental causes, mutation (gene and chromosomal), polyploidy etc. 3. Define somatic and genetic variation, continuous and discontinuous variations. 4. Describe the significance of variation.	• Definition of heredity and variation • Explanation of causes, types, and significance of variation • Definition of terms: chromosome, gene, alleles, genotype, phenotype, and homozygous, heterozygous, clone • Structure of DNA and RNA and DNA

5. Define the terms: Chromosome, gene, alleles, genotype and phenotype, homozygous and heterozygous and clone. 6. Study about structure of DNA and RNA 7. Replication of DNA 8. Define mutation. 9. Causes and effects of mutation	replication (eukaryotic model) • Mutation
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams.
3.2 Mendel's Law of Inheritance	**Theory: 5 hrs**
Objectives	Contents
1. Explain Mendel's experiments. 2. List the reasons for selecting pea plant by Mendel in his experiment. 3. Define monohybrid and dihybrid crosses. 4. Mendel's laws: Law of dominance, Law of Segregation, law of independent assortment.	• Description of Mendel's hybridization experiments-monohybrid and dihybrid crosses • Description of Mendel's laws and ratios
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, and diagrams, show pea plants and introduce its different parts.
Unit 4: Economic Botany	**Theory: 4 hrs**
4.1: Food Plants	**Theory: 2 hrs**
Objectives	Contents
1. List some important food plants of Nepal including cereals, pulses, vegetables and fruit plants . 2. List the parts of food value for above-mentioned plants.	Some important food plants of Nepal and their parts of food value.(Cereals, Pulses, Vegetables, Fruits)
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams and herbarium specimens of medicinal plants.

4.2: Medicinal Plant	**Theory: 2 hrs**
Objectives	Contents
List some important medicinal plants of Nepal.	Some important medicinal plants of Nepal and their uses.
Evaluation: 1. Oral and written tests, home assignment. **2.** Types of questions: Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams and herbarium specimens of medicinal plants.
Unit 5: Biotechnology	**Theory: 6 hrs**
Objectives	Contents
1. Define Biotechnology. 2. List the branches of Biotechnology. 3. List the application of Biotechnology. a. Fermentation technology b. Agriculture: biofertilizers and biopesticides c. Tissue culture d. Genetic engineering e. Antibiotics and vaccines f. Amniocentesis and test tube baby	• Definition, branches and applications of Biotechnology. • Various disciplines of biotechnology: brief introduction
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, and diagrams.

Botany II: Practical

Course: Botany Practical	**Hours: 20**
Practical 1: Physiology	**Practical: 7 hrs**
Objectives 1. Study diffusion using copper sulphate crystals put in a beaker of water. 2. Study osmosis through egg membrane and potato osmoscope. 3. Study of transpiration by bell jar experiment. 4. Demonstrate experimentally that oxygen is evolved during photosynthesis. Demonstrate experimentally that carbon dioxide is necessary for photosynthesis.	• Contents • Study of diffusion using copper sulphate crystals put in a beaker of water • Study of osmosis through egg membrane and potato osmoscope. • Study of transpiration by bell jar experiment • Demonstration of evolution of oxygen during photosynthesis. • Demonstration of requirement of carbon dioxide during photosynthesis

Practical 2: Molecular Biology	**Practical: 5hrs**
Objectives 1. Test presence of reducing sugars in the given sample using Benedict's solution. 2. Test presence of starch in given sample using Iodine solution. 3. Test presence of protein in given sample using Biuret method. 4. Test presence of lipid in given sample using emulsion method.	Contents • Benedict test of Reducing Sugar. • Iodine test of Starch. • Biuret test of Proteins. • Emulsion test of lipids.
Practical 3: permanent slides	**Practical: 4hrs**
Objectives Study of different types of plant tissues using permanent slides.	Contents Identification and study of different plant tissues
Practical 4: economically important plants	**Practical: 4 hrs**
Objectives Demonstration of economic importance of some plants.	Contents Any two economically important plants.

Zoology II

Course Description

This basic course in zoology discusses about origin and evolution of human beings and other animals. It also describes different aspects of human physiology, characteristics of migratory birds and fishes, environmental pollution.

Course objectives

After completing this course the students will be able to:

- Explain concept of origin and evolution
- Explain different physiological processes of human being
- Describe how organisms of today have been evolved from the ancestral ones
- Describe different types of environmental pollution
- Describe different aspects of wildlife

Minimum standards

Students must achieve a minimum of 40% accuracy in theory, 60% accuracy in lab.

Recommended Text Books:

A text Book of Biologicy Part II - Aggrawal, S.
Modern Text Book of Zoology, Invertebrates - Kotpal, R. L.
Modern Text Book of Zoology, Vertebrates - Kotpal R. L.
A Textbook of Higher Secondary Biology, Vol I & Vol II - Arvind K. Keshari, Ghimire, Mishra & Adhikari
Practical Zoology (Invertebrate) - P. S. Verma

Zoology II	**58Hrs**
Unit:1 Basic concept of origin and evolution of life.	**Hrs. 12 theory**
Objectives	Contents
1. Define evolution and organic evolution. 2. Describe historical background of organic evolution. 3. Give examples of organic evolution. 4. Describe the evidences of organic evolution: morphological and anatomical palaeontolgical, biochemical, genetic and embryological. 5. Describe the Lamark's theory of evolution 6. giving examples cited by him. 7. Describe the Darwin's theory of evolution with	• Evolutionary history of organisms. • Evidences of organic evolution. • Different theories of organic evolution.

examples. 8. Identify drawbacks of Darwin's theory of evolution. 9. Identify drawbacks of Darwin's theory. 10. Describe the origin and evolution of man 11. Describe modern synthesis theory of evolution.	
Evaluation methods: oral test, home assignments, written examination.	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self-study.
Unit 2: Study of life process of mammals	**Hrs. 20 theory**
Objectives	Contents
1. Give the systematic position and morphology of man with sketch. 2. Describe the digestive system, respiratory system, circulatory system and excretory system of man	• Systemic position and morphology of man. • Digestive system, Respiratory system, Circulatory system • Excretory system (Anatomy and physiology).
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study
Unit 3: Growth and reproduction	**Hrs. 8 theory**
Objectives	Contents
1. Embryonic development of frog 2. Sexual and asexual reproduction in animals 3. Sex determination	• Events before and during embryonic development • Sexual and asexual reproduction in animals • Sex determination in mammals
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study
Unit 4: Biodiversity	**Hrs. 4 theory**
Objectives	Contents
Habit, habitat, distribution and migratory behavior of fishes and birds	Migratory fishes and birds
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study

Unit 5: Environmental pollution	**Hrs. 10 theory**
Objectives	*Contents*
1. Define pollution. 2. List biodegradable pollutants. 3. List nonbiodegradable pollutants. List the sources of water pollutants. 4. Identify the causes of water pollution. 5. List the effects of water pollution 6. List the preventive measures to control the water pollution. 7. List the source of air pollution. 8. List the effects of air pollution 9. Mention the preventive measures to control air pollution. 10. List the source of soil pollution. 11. List the effects of soil pollution. 12. List the preventive measures to control soil pollution.	• Definition of air pollution and pollution. • Types of pollution. • Source of water pollution, their effect and preventive measures. • Source of air pollution, their effect on living organisms and preventive measures of air pollution. • Source of soil pollution, their effect and preventive measures.
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
Unit: 6 Conservation of wildlife	**Hrs. 4 theory**
Objectives	Contents
1. Define wildlife. 2. Define the endangered species. 3. List the endangered species of Nepal and causes of extinction. 4. Define the rare and threatened animals with examples. 5. List the methods to conserve the wild life. 6. Give the methods to conserve the forest. 7. Explain the importance of afforestation. 8. List the national parks and wildlife reserves of Nepal.	• Definition of wildlife • Importance of wildlife conservation • Categories of wildlife. • Endangered species in Nepal and causes of extinction • National parks, wild life reserves of Nepal • Conservation strategy. • Forest conservation, important of afforestation Causes and consequences of deforestation.
Evaluation methods: oral test, home assignments, written examination.	**Teaching learning activities and resources:** classroom instruction, discussion textbooks, and reference books self study.

Zoology II: Practical

Course: Practical Zoology	**Hrs .lab 20**
Practical 1: Physiology	**Practical: 5 hrs**
Objectives 1. Demonstrate that carbon dioxide is evolved during aerobic respiration. 2. Demonstrate that carbon dioxide is evolved during fermentation.	Contents • Demonstration of evolution of carbon dioxide during aerobic respiration • Demonstration of evolution of carbon dioxide during fermentation
Practical 2: permanent slides	**Practical: 4 hrs**
Objectives 1. Study of different types of animal tissues using permanent slides. 2. Study of the structure of the histology of different parts of the body	Contents • Identification and study of different animal tissues • T.S of oesophagus • T.S of duodenum, T.S of liver. • T-S of pancreas, • T.S lung, T.S of kidney
Practical3: temporary slides	**Practical: 5hrs**
Objectives	Contents
1. Prepare the temporary slide. 2. Study the prepared slide 3. Draw the well labeled diagram provide comments on the diagrams.	• Striated muscle (thigh of frog) • Setae of earthworm
Practical4: chart preparation	**Practical: 3hrs**
Objectives	Contents
Prepare charts related to genetics	Chart (Mendelian Inheritence)
Practical 5: soil	**Practical: 3hrs**
Objectives	Contents
Determination of texture and moisture of soil sample	Texture and moisture of soil sample

Third Semester

Basic Principle of Engineering

Total hours: 156 **Full Marks: 100**
Theory 117
Practical: 39

Course description:

The course in Basic Principles of Engineering is designed to provide student knowledge on the fundamental principles of engineering applied in the subject area of food science and in industries related to food processing. The course covers various areas in fundamentals engineering from simple object drawing, to various other areas in electricity, mechanical, engineering.

Course objective:

Upon completion of the course the students will be able to:

- Understand and carry out engineering drawing of objects with simple geometry
- Understand basics of conversion
- Understand principles of electricity
- Understanding on working and applications of valves,
- Understand working and application of power transmission devices
- Understand applicability of fundamental principle sin engineering in food science studies and food industries

Minimum Standard

Students must achieve a minimum of 60 % in practical examination and 40% of full marks in the theory.

Recommended Texts

1. Toledo, Romeo T, Fundamentals of Food Process Engineering, Third edition, Springer publication
2. ND Bhatt, Elementary Engineering Drawing
3. SB Mathur and S Domkundwar, Mechanical Engineering, Dhanpat Rai and Sons,Delhi
4. PK Nag Engineering Thermodynamics, Tata McGraw Hill Publishing Co. Ltd, New Delhi
5. SC Arot& S. Demkundwar, A course in Refrigeration and air conditioning. Dhanapat Rai & C. (Pvt) Ltd, Delhi

Course: Basic Principles of Engineering	**Theory: 117hrsPractical39hrs**
Unit 1: Unit, Dimension and their conversion	**Theory: 7hrs**
Objectives	Contents
Understand the concepts of Units, Dimensions and unit conversion	Concepts of Units and Dimension, Fundamental and derived units, Introduction to various systems of units: MKS and English Units, Unit conversion exercise with special reference to SI system
Evaluation: Oral and written tests, home assignments.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams
Unit 2: Basic engineering drawing	**Theory: 12hrs**
Objectives	**Contents**
Understand basic concepts of engineering drawing	Elementary idea ofdrawing objects: Orthographic projection: first and third angle projections,and isometric projection
Evaluation: Oral and written tests, home assignment.	**Teaching Methods:** Classroom instruction, Class room demonstration, textbooks, reference books, charts, diagrams, photographs, drawing of various objects
Unit 3: Fluids	**Theory: 13 h**
Objectives	**Contents**
Understand basic concepts of Newtonian and non-Newtonian fluids and Bernoulli's equation	Fluids, compressible and incompressible fluids, Shear stress and shear rate, viscosity,Newton's law of viscosity, Newtonian and non-Newtonian fluids and their types, equation of continuity, Bernoulli's equation, its assumption, limitation and uses.
Unit 4: Steam and steam generation devices	**12 h**
Objectives	Contents
Understand the steam generation principle and the equipment'sinvolved	Specific heat capacity, Sensible and latent heat, phase diagram of water, Calculation of energy needed to generate steam, Wet, dry and superheated steam, Boilers: boilers utilities and accessories, Water tube and fire tube boilers, their relative merits and demerits

Unit 5: Psychrometry	**12 h**
Objectives	**Contents**
Understand the psychrometric properties and application of psychrometric chart	Air and its composition, definitions and general understanding of psychrometric properties: dry bulb temperature, wet bulb temperature, humidity ratio, relative humidity, dew point temperature, specific volume, psychrometric chart, psychrometric processes and application to find psychrometric properties of air. Application of psychometry in food processing
Unit 6: Simple electrical principle	**Theory:12hrs**
Objectives	Contents
Learn concept of AC and DC current and the devices	Simple electrical principle: AC and DC current, Faraday's law, single phase and 3-phase, transformers, fuse, switches, insulators and insulation materials,Fleming's rule, electrical motors, motor controller, generators and dynamo, power factor, etc.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs. Audio-visuals
Unit 7: Simple Mechanical principles and power transmission	**Theory: 12hrs**
Objectives	Contents
1. Understand fundamental concepts of concept of velocity, acceleration, energy, momentum, force, power 2. Working and industrial application belt drive, gear drive, chain drive	• Concept of velocity, acceleration, energy, momentum, force, power • Working principles and industrial applications mechanical power transmission: belt drive, gear drive, chain drive and their application • Structure and function of Bearings, coupling, shaft, cranks.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, and audio-visuals
Unit 8: Refrigeration	**Theory: 12hrs**
Objectives	Contents
Understand working principleof refrigeration system and merits and demerits of various types of refrigerants	Principles of refrigeration, Units of refrigeration (calculation of tonnes of refrigeration), different types refrigeration (vapor compression and vapor absorption), introduction, types and desirable properties of refrigerants,Application of refrigeration system in food industries

Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books, charts, diagrams, photographs audio visuals
Unit 9: Liquid Pumping devices	**Theory: 4hrs**
Objectives	Contents
Learn working principles and application of various types of pumps used on food and dairy industries	Types of pump: Centrifugal pump and gear pump and their uses, uses of pump,
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, audio vusuals
Unit 10: Measurement devices	**17 h**
Objectives	Content
Understand working principles and uses of various measuring devices	• Working principles and uses of various types of: • Temperature scales,Temperature measuring devices, liquid in glass thermometers, resistance thermometer (thermistors and resistance thermal detector, RTD), pyrometer • Concept of pressure and hydrostatic pressure, gauge and absolute pressure, mechanical manometer(bourden gauge tube, diaphragm) liquid in tube manometers (piezometer,simpleU-tube manometer, differential manometer) and calculations • Flow measuring devices (rotameter,venturimeter and rotameters)
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.

Practical

Practical	Hrs
Learn working of electric motor and electric generator and carry out their simple drawing	3h
Use of psychrometric chart to solve psyhrometric properties of air	6h
Working of refrigeration system and simple schematic drawing	6h
Orthographic projection	9h
Isometric projection	6h
Industry visit and report writing (main objective is to learn about measuring devices, pumps, refrigeration system, boilers, power transmission systemetc)	9h

Principles of Food Preservation

Credit hours: (4+2) hours/week
Total hours: 117 **Full Marks: 75**
Theory 78
Practical: 39

Course Description

This course provides the theoretical as well as practical knowledge to the students in food preservation. After completion of this course, students gain knowledge about the underlining principles of basic food preservation methods such as dehydration, drying, freezing, canning, irradiation, and preservation by natural and chemical preservatives. This course also includes history of food preservation, microbial preference for spoilage, and food deterioration.

The practical components of this course are designed to supplement learning through the application of learned theories. The students will handle simple apparatus to do simple measurements, learn food preservation techniques and apply their knowledge in food industries.

Course Objectives

This Course has the following Objectives:

- Explain factors affecting food spoilage and process of food spoilage
- Describe mechanism of drying and process of dehydration
- Define cellar storage, chilling storage and types of chilling storage.
- Explain the freezing procedures of some food items.
- Describe history of thermal processing of foods, heat resistance of microorganisms and factors affecting heat resistance.
- Describe containers in canning foods, types of containers, fillers and heat penetration in canned foods.
- Explain aseptic canning and spoilage of canned foods.
- Explain generation of ionizing radiation and terms and units used in irradiation.
- Explain effects of irradiation on nutrients, packaging materials, quality of irradiated foods and dose applied in irradiation.
- Explain types of preservatives, mode of action of preservatives on microorganisms and examples of suitable preservatives for different food.

Minimum standards
The students must achieve a minimum of 40% in theory and 60% accuracy in practical.

Text and Reference books
Principles of Food Preservation – Ganga P. Kharel and Fumio Hashinaga
The technology of Food Preservation – N.W .Desrosier and J.N Desrosier
Food Science – N.N. Potter

Course : Principles of Food Preservation	**Hrs. Theory :78 Hrs. Practical :39**
Unit 1: Introduction and historical development of food preservation	**Hrs. Theory:4**
Objectives	Contents
1.1 Define Food Preservation	• Definition of Food Preservation
1.2 Describe history of microbial spoilage of food	• History of microbial spoilage of food
1.3 Study history of canning ,food freezing, drying and food irradiation	• Historical development of canning food, food freezing, food drying and food irradiation
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.
Unit 2: Food spoilage	**Hrs. Theory: 8**
Objectives	**Contents**
2.1 Understand food spoilage and its types and factors responsible	Definition of food spoilage -Food spoilage by microorganisms (bacteria, fungi: yeasts, molds) -Enzymatic food spoilage -Spoilage by chemical reaction -Spoilage by pests Intrinsic and extrinsic factors
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.
Unit 3: Food preservation by Dehydration and Drying	**Hrs. Theory: 8**
3.1 Understand principles of Food preservation by Dehydration and Drying	• Definition of moisture content and water activity along with formula • Table illustrating moisture content of some foods • Differences between drying and dehydration • Movement of moisture during drying; drying curve • Illustrate drying operations • Hot air driers; heated surface driers; freeze drying
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.

Unit 4 : Food preservation by low temperature	**Hrs. Theory:16**
4.1 Understand principles, process and means of Food preservation by low temperature	Principle of food preservation by low temperature, Principle of cellar storage, Temperature range of chilling storage, Modified atmospheric storage (MAS), Controlled atmospheric storage (CAS), Description of chilling effects on microbial growth, Definition and principle of food preservation by freezing, Figurative explanation of freezing a typical type of food, Differences between quick freezing and slow freezing, Classification of freezing equipments: mechanical freezer and cryogenic freezer, Effects of freezing on microbial growth; freezing rate and its effect on quality of food; effects of freezing and frozen storage, Definition of thawing, Methods of thawing, Flowcharts of freezing peas, carrot and meat, Tabulation of shelf life of common foods in refrigeration and freezing temperatures
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.
Unit 5: Food preservation by Thermal processing	**Hrs. Theory:20**
5.1 Introduce food preservation by thermal processing	• Principle of food preservation by high temperature
5.2 Study different forms of heat treatment	• Definition of Pasteurization and canning
5.3 Explain factors affecting extent of heat treatment	• Explanation of factors: heat resistance of microorganism, pH of food, heating conditions, thermo-physical properties of food, shape and size of container and storage conditions after processing .
5.4 Classify foods on the basis of pH	• Classification of foods on the basis acidity, low acidity and medium acidity
5.5 Describe history of thermal processing of foods	• Historical development of Pasteurization and canning processes
5.6 Describe heat resistance of microorganisms	• Heat resistance of thermophiles, mesophiles and psychrophiles
5.7 Study factors affecting heat resistance	• Heat resistance due to history of microorganisms, pH and composition of food, types of heat
5.8 Define canning/ Appertization	• Definition of canning
5.9 Explain general process of canning fruits and vegetables	• Self-explanatory flowchart of canning fruits and vegetables

5.10 Study containers of canning foods	• Definition of containers • Ideal properties of containers
5.11 Differentiate types of containers	• Explanation of Metal containers -desirable properties of metal cans -process of can seam formation -lacquering and its types(acid resistant lacquer; sulfur resistant lacquer) • ii. description of glass containers, aluminum containers and flexible pouches
5.12 Study of fillers used in canning	• Description of fillers • Types of fillers • Desirable properties of fillers
5.13 Explain heat penetration in canned foods	• Description of Heat transfer in can by conduction and convection -Factors influencing heat penetration -types of product -size of container -head space -Agitation of the container -Temperature of the retort -shape of the container -type of container
5.14 Describe methods of heating	• Heating of can by -saturated steam -hot water -flame
5.15 Study types of processing equipments	• Definition of retort • Description of batch retort, crateless retort and agitating retort
5.16 Measurement of sterility and determination of process time	• Definition of thermal death time (TDT) • Process time calculation • Definition of -D value -Z value -F value
5.17 Study aseptic canning	• Description of aseptic caning • Advantages of aseptic canning over conventional canning • Process flowchart of aseptic canning system (Dole Process)
5.18 Study spoilage of canned foods	i. Description of spoilage a. physical and chemical spoilage -over filling -under exhausting -foreign flavors -corrosion of cans

	-Paneling -damage due to rough handling -discoloration due to chemical changes b. microbiological spoilage -pre processing spoilage -under processing -after processing ii. Description of blown cans -flat -flipper -springer -soft swell -hard swell
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.
Unit 6: Food preservation by Irradiation	**Hrs. Theory:15**
6.1. Define electromagnetic radiations	• -Definition of electromagnetic radiations • -electromagnetic spectrum
6.2. Define irradiation of food	• Description of irradiation
6.3. Introduction to ionizing radiation	• Description of α(alpha) particles, β(beta) particles and ϒ(gama) radiations
6.4. Define terms and units	• Radappertization, Curie, Becquerel, rad and Grays
6.5. Explain generation of ionizing radiation	• radioactive sources • machine sources
6.6. Illustrate scope of irradiation in food processing	• Description of scope of irradiation in food processing
6.7. Illustrate principle/ mode of action of irradiation	• Direct • indirect effect (radiolysis of water; formation of radicals)
6.8. Study of irradiation effects	• Irradiation effects on microorganisms, parasites and enzymes
6.9. Describe irradiation effects on nutrients	• Effects in protein, carbohydrates, lipids and vitamins
6.10. Explain irradiation effects on packaging materials	• Effects on paper, plastic and glass
6.11. Define radiation dose	• Maximum recommended dose and safety aspect • applicable irradiation dose in some foods
6.12. Enumerate quality of irradiated foods	• Merits and demerits of irradiation in quality of food
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.

Unit 7 : Food preservation by preservatives	**Hrs. Theory:8**
7.1. Define preservatives	Definition and description on preservatives
7.2. Enumerate types of preservatives	-class I preservatives -class II preservatives
7.3. Describe natural preservatives used in food	• Example of appropriate foods , optimum dose and mode of action of : -sodium chloride (NaCl) -sugars -ethanol -acetic acid -wood smoke -spices and essential oils
7.4. Describe types of chemical preservatives used in food	• Example of appropriate foods , optimum dose and mode of action of: -benzoic acid -sulphur dioxide -nitrates and nitrites
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration of diagrams and visual aids, text books and reference books.

Practical

Principles of Food Preservation Practical	**Hrs Practical: 39**
Practical 1: Determination of moisture content of food	**Hrs: 4**
Objectives	Contents
To determine moisture content of given food samples	Determination of moisture content of different foods like biscuit, cereals, flour, dough and legumes.
Practical 2: Carry out testing of cans	**Hrs: 4**
Objectives	Contents
To observe a thermally processed canned food	Observation of thermally processed apple/ pineapple/ mango/mushroom can
Practical 3: Testing adequacy of blanching	**Hrs: 6**
Objectives	Contents

To determine blanching time of fruits and vegetables	Determine the blanching time of the given fruits and vegetables performing two tests: -catalase test -peroxide test
Practical 4: Determination of pH of food	**Hrs: 4**
Objectives	Contents
To determine pH of food	Determination of pH of given food samples
Practical 5: Determination of D value	**Hrs: 4**
Objectives	Contents
To calculate and determine D value of microorganism in thermally processed can	For example: Determination of D value at 111° C for Clostridiumbotulinum (Z=10°C) when D value at 121 °C is 0.2 minutes
Practical 6: Determination of F value	**Hrs: 4**
Objectives	Contents
To calculate and determine F value of microorganism in thermally processed can	For example: Determination of F value required to reduce Clostridiumbotulinum (Z=10°C, D_{121} =0.2 minutes) spore count from 10^{2} to 10^{-6} per can at 115°C
Practical 7: Study shelf life of refrigerated and frozen storage of meat/fish/eggs	**Hrs: 6**
Objectives	Contents
To carry out refrigerated storage of meat/fish/eggs	Observation of refrigerated and frozen storage of meat/fish/eggs
Practical 8: Drying fruits/vegetables	**Hrs:6**
Objective	Contents
To carry out drying of fruits and vegetables	Perform drying and shelf life study of fruits and vegetables

Principles of Milk Processing

Credit hours: 4+2 = 6 hours/week
Total hours: 117 **Full Marks: 75**
Theory 78
Practical: 39

Course description

The course covers all unit operations applied in milk processing, viz., momentum transfer, heat transfer, phase separation, mixing, enzymatic transformation, physical transformation, and stabilization. The milk processing covered in this course are collection and reception, pasteurization, transformations, and packaging.

Course objectives

1. To apply unit operations in dairy processing
2. To study the working principles of all principal equipment used in dairy processing
3. To understand various stabilization and transformation processes

Text and reference books

1. Bylund, C. (2003). Dairy Processing Handbook, 2nd Edition. Tetrapak Processing Systems AB, Sweden
2. Adhikari, R.P. and Bhandari, C. (2005). Production Technology of Dairy Products (Nepali version). Janajyoti Pustak Pasal, Kathmandu, Nepal.
3. Behare, P., Minz, P.S., Mandal, S., Kumar, S. and Cichudde, D.A. (2013). Fluid milk Processing: Student Handbook for Class XI. CBSE, Delhi
4. FAO. (2010). Dairy Sector Study of Nepal, FAO
5. Goff, D. (??). Dairy Science and Technology (education series)., University of Guelph
6. Ebing, P. and Rutgers, K. (2006). Preparation of Dairy Products (Agrodok 36). Agromisa Foundation and CTA, Wageningen
7. Varnam, A.H. and Sutherland, J.P. (1994). Milk and Milk Products: Technology, Chemistry and Microbiology. Chapman & Hall, London.

THEORY

Course: Principles of milk processing	**Theory: 78 h Practical: 39 h**
Unit 1: Milk	**Th: 6 h**
Objectives ○ To provide background for milk composition and quality ○ To study gross composition of different milks (cow, buffalo, yak, human)	*Contents* ○ Definition, gross composition and comparison (cow, buffalo, human) ○ Milk quality (platform- and payment tests, milk grading)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

Unit 2: Milk secretion and ejection	**Th: 6 h**
Objective ○ To know mechanisms of milk secretion and ejection ○ To study factors affecting milk composition and yield	○ Overview of milk secretion in alveoli ○ Ejection reflexes (inward and outward) ○ Factors affecting milk yield (genetic and environmental)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 1: Unit operations in milk processing	**Th: 18 h**
Objectives To apply unit operations at various stages of milk processing ○ To study heat transfer, homogenization and cream separation	*Contents* ○ Transfer of momentum (pumping, flow) ○ Heat transfer (heating and cooling) ○ Phase separation (churning, cream separation, cyclone separation) ○ Mixing/comminution (stiring, homogenization, recombination) ○ Molecular separation (membrane processes) ○ Physical transformation (gel formation, emulsification) ○ Microbial and enzymatic transformations (rennet action, ripening) ○ Stabilization (heating, cooling)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 2: Collection and reception of milk	**Th: 5 h**
Objectives ○ To gain knowledge on milk collection system, with emphasis on developing countries. ○ To identify the problems encountered in milk collection ○ To know milk pricing system	*Contents* ○ Description of milk shed areas, chilling centers and collection centers ○ Requirements for establishing chilling centers ○ Problems of milk collection ○ Milk producers' cooperatives (MPCs) ○ Platform and payment tests
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 3: Stabilization of milk	**Th: 18 h**
Objectives ○ Learn different methods used for preventing milk spoilage (emphasis on heating and cooling) ○ To know about heat processing of milk ○ To know lactoperoxidase system in raw milk preservation	*Contents* ○ Cooling (purpose, equipment and process) ○ Pasteurization(definition, process and advantages) ○ UHT process (Definition, types and sub-types, equipment and process) ○ Sterilization (definition, types, equipment and process) ○ LP system (definition, mechanism of stabilization)

Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 4: Phase separation	**Th: 4 h**
Objectives ○ To know the mechanisms of separation of fat from the continuous phase and the equipment used ○ To know principles of cream separation ○ To study theory of churning	*Contents* ○ Theory of cream separation ○ Equipment and process (for separation) ○ Theory of churning to make butter ○ Equipment and process
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 5: Transformation	**Th: 17 h**
Objectives ○ To gain knowledge on the transformation of fluid milk into a variety of solid, semi-solid and frozen products. ○ To study the ice cream freezer and its operation ○ To study the cream separator and its operation ○ To study spray dryer and its operation	*Contents* ○ Equipment and process for ice cream manufacture ○ Operation and function of freezer ○ Equipment and process for cheese making ○ Equipment and process for milk powder (spray and roller) ○ Equipment and process for yogurt making ○ Equipment and process for butter making ○ Equipment and process for ghee making ○ Equipment and process for reconstitution and recombination
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 6: Packaging	**Th: 4 h**
Objective ○ Know packaging requirements of milk and derived products, along with the process and equipment ○ To study the operation of form-fill-seal machine ○ To study aseptic packaging process ○ To study the canning machine for milk products	*Content* ○ Canning (method and equipment) ○ Bottling (method and equipment) ○ Flexible packaging (method and equipment) ○ Aseptic packaging (method and facility) ○ Secondary, tertiary and quaternary (transport) packaging of milk and milk products.
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

PRACTICAL

Course: Principles of milk processing	**Practical: 39 h**
Practical 1: Study the working of cream separator	**7 h**

Objectives ○ To know the working principle of cream separator ○ To study the different parts of cream separator	*Contents* ○ Make labeled drawings of the equipment ○ Carry out test-operation and calculate the creaming efficiency
Practical 2: Study the working of butter churner	**7 h**
Objectives ○ To know the working principle of butter churner in phase separation ○ To study the different parts of butter churner	*Content* ○ Operate butter churner ○ Prepare table butter
Practical 3: To study working of ice cream freezer	**7 h**
Objectives ○ To know mechanism of freezing, whipping and mixing ○ To study the different parts of ice cream freezer	*Content* ○ Operate batch ice cream freezer ○ Prepare test ice cream to observe completeness of mixing
Practical 4: Prepare reconstituted or recombined milk	**7 h**
Objectives ○ To learn reconstitution and mixing of components ○ To prepare reconstituted and recombined milk	*Content* ○ Exercise on calculation of required quantities of different components for recombination (fat, water, skim milk)
Practical 5: One day visit to cheese processing plant and dairy industry	**11 h**
Objectives ○ Know the full-scale processing system for cheese, market milk, yogurt and ice cream	*Content* ○ Study different types of equipment (homogenizer, cream separator, boiler, plate heat exchanger, filling machines ○ Arrangement of interactive session in the cheese and market milk plant

Basic and Food Microbiology

Credit hours: 4+2 hours/week
Total hours: 117 **Full Marks: 75**
Theory 78
Practical: 39

Course description

The course covers all the basic aspects of microbiology and food microbiology. This includes historical development of microbiology, scope, classification and culture of microorganisms, exploitation of useful microorganisms, and control of pathogenic/undesirable/spoilage ones.

Course objectives

1. To familiarize students with microbes present in food and allied environment
2. Provide technical skills on culturing, preservation and sterilization procedures
3. Provide skills on isolation, characterization and enumeration of yeasts, bacteria and molds

Text and reference books

1. Hogg, S. (2013). Essential Microbiology. 2nd Edition. John Wiley-Blackwell Publication, England
2. Kumar, S. (2016). Essentials of Microbiology. Jaypee Brothers Medical Publishers (P) Ltd. Bhotahity, Kathmandu
3. Montville, T.J., Matthews, K.R. and Kniel, K.E. (2008). Food Microbiology: An Introduction. 2nd Edition. ASM Press, Washington
4. Goldman, E. and Green, L.H. (2009). Practical Handbook of Microbiology. 2nd Edition. CRC Press, New York
5. Rai, B.K. (2007). Basic and Food Microbiology. Lecture Manual (self-archived)
6. Rai, B.K. and Limnu, D.K. (2016). Basic Practical Manual on Industrial Microbiology. Lulu Publ. USA.

THEORY

Course: Basic and Food Microbiology	**Theory: 78 h Practical: 39 h**
Unit 1: Scope and importance of microbiology	**Th: 3 h**
Objectives ○ familiarize with importance of microbiology ○ Understand microbial associations and their interactions with environment	*Contents* ○ Importance of microbiology in food, pharmaceutical, water, air, and soil. ○ Associations of microorganisms with food, water, environment, and humans
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 2: Historical development	**Th: 4 h**
Objectives ○ Understandthe contributions by different investigators and scientists in the field of microbiology ○ Understandchronology of evolution of microbiology and microbiological techniques	*Contents* ○ Chronology of developments ○ Spontaneous generation ○ Koch's postulates ○ Pasteur and his contribution

Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 3: Classification of microorganisms	**Th: 4 h**
Objectives ○ Introduce different systems of classification ○ Study the diagnostic characteristics of different classes/groups of microorganisms	*Contents* ○ Scientific nomenclature ○ Bases of classification ○ Classification based on growth temperature, oxygen requirement, and mode of nutrition
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 4: Microscopy	**Th: 6 h**
Objectives ○ To familiarize with working principles and uses of different types of microscopes ○ To carry out micrometric calculations	*Contents* ○ Types and sub-types of microscopes (light and electron) ○ Resolution and resolving power ○ Use of immersion oil ○ Micrometry
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 5: Nutrition and culture of microorganisms	**Th: 8 h**
Objectives ○ Understandthe nature and nurture aspects of microorganisms ○ Classify media and study their composition ○ Learn the principles of pure culture technique (streaking, spreading)	*Contents* ○ Growth requirements of microorganisms ○ Growth curve ○ Nutritional requirements ○ Growth in artificial environment ○ Different types of culture media ○ Plating and streaking techniques
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 6: Factors affection growth of microorganisms	**Th: 6 h**
Objectives ○ Acquire the knowledge on factors that can be manipulated to control (encourage or inhibit) the growth of microorganisms ○ Introduce common terminologies (hurdle, antisepsis, preservatives, disinfection)	*Content* ○ Physical agents (heat, pH, water activity, oxygen, irradiation, etc.) ○ Chemical agents (preservatives, antiseptics and disinfectants) ○ Concept of hurdle technology ○ Botulinum cook
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

Unit 7: Aseptic operation	**Th: 6 h**
Objectives o Understandr the basic principles of working in contamination-free system o Introduce relevant terminologies (asepsis, sterile zone, inoculation) o	*Content* o Definitions (asepsis, antisepsis and disinfection) o Techniques (sterile zone, aseptic pipetting, plating and inoculation, disinfection of working table)
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 8: Staining techniques	**Th: 6 h**
Objectives o Acquire the knowledge on use of different types of stains and dyes for microscopic examination of cells o Learn the basic principles of staining (negative staining, endospore staining, Gram staining)	*Content* o Purpose o Classification of stains and dyes o Examples of use of different types of staining (relief, differential, simple, compound, etc.) o Theory behind each staining methods
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 9: Identification of microorganisms	**Th: 6 h**
Objectives o Understanddiagnostic features of microorganisms (staining reaction and colony characteristics)	*Content* o Diagnostic features (morphology, colony characteristics, biochemical differentiation, staining reactions)
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 10: Microbiology of food and water	**Th: 8 h**
Objectives o Introduce the idea about natural flora and spoilage/pathogenic microorganisms o Study about food poisoning and the causative organisms	*Content* o Natural flora of meat, fruits and vegetables, eggs, spices and milk o Spoilage organisms o Pathogens in food (*Aspergillus flavus*, *Salmonella*, *Clostridium botulinum*, *Listeria*, *Mycobacterium*, etc.) o Index- and indicator organisms
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 11: General principles underlying food spoilage	**Th: 5 h**
Objectives o Acquire the knowledge on general principles underlying food spoilage o Differentiate between food spoilage and defects	*Content* o Differentiation between food deterioration and food spoilage o Differentiation between food spoilage and defects o Examples of food spoilage (meat, dairy, fruits and vegetables)

	○ Principles of methods used to prevent food spoilage (physical, chemical, hurdles, etc.)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 12: Enumeration of microorganisms	**Th: 7 h**
Objectives ○ Carry out quantitative measurement of cell number (microbial load) of different food items ○ Learn calculate relevant calculations (dilution factor, microscopic factor, calibration of ocular micrometer)	*Content* ○ Review of methods and their principles for enumeration of microorganisms (direct microscopic count, plate count, etc.) ○ Principles of direct microscopic count ○ Principles of plate count ○ Principles of use of selective-cum-differential media for enumeration ○ Colony forming units
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 13: Food borne illness	**Th: 6 h**
Objectives ○ Understandthe different food-borne illnesses ○ Introduce causative agents-, food implicated-, and prevention of food poisoning	*Content* ○ Definitions of food-borne illness, food infection, food intoxication, food toxico-infection and their examples ○ Description of common food-borne illnesses (salmonellosis, staphylococcal poisoning, botulism, aflatoxicosis, shigellosis, etc.) ○ Preventive measures ○ Identification of causative agents
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 14: Principles of sanitation and hygiene	**Th: 3 h**
Objectives ○ Introduce idea on measures that can be used for maintaining sanitation and hygiene in food establishment ○ Learn and use preventive measures for controlling microbial problems	*Content* ○ Definitions of sanitation and hygiene ○ Cross-contamination ○ Sources of contamination and preventive measures ○ Sanitizing agents and their use in food establishment ○ Design of food establishment (layout, piping, waste treatment)

PRACTICAL

Course: Basic and Food Microbiology	**Practical: 39 h**
Practical 1: Study of microbiology lab equipment and glassware	**4 h**
Objectives o familiarise with different equipment/glassware o know the correct techniques of handling/operating equipment/glassware	*Contents* o Make labeled drawings of the equipment/glassware o Write down the functions of each item studied
Practical 2: Operate/handle lab equipment/glassware	**4 h**
Objectives o know the correct/safe method of operating/handling lab equipment and glassware o calibrate equipment (pH meter, microscope)	*Content* o Operate autoclave o Operate hot air oven o Operate vortex mixer o Use colony counter o Use pH meter o Use electronic balance o Use microscope o Handle Petri plates o Handle inoculating loops and needles (including sterilization by incineration)
Practical 3: Media Preparation	**6 h**
Objectives o prepare media o carry out aseptic plating	*Content* o Understand the label information o Prepare media (PDA and NA) o Sterilize media o Store or plate out media o Practice aseptic plating techniques
Practical 4: Negative staining of yeast cells	**3 h**
Objectives o prepare smear for carrying out negative staining o use oil immersion objective	*Content* o Prepare smear o Prepare negative stain (using nigrosine) o Observe cells under oil-immersion objective o Record the cell morphology
Practical 5: Micrometry	**5 h**
Objectives o measure cell sizes o calibrate ocular micrometer o calculate microscopic factor	*Content* o Calibration of ocular micrometer o Measurement of cell size (length and breadth) o Observe cell organization and other details (e.g., budding in yeast) o Exercise statistical analysis (mean and standard deviation using computer)
Practical 6: Enumeration of bacteria in food sample	**5 h**
Objective o prepare food samples o carry out serial dilution	*Content* o Prepare food sample o Carry out serial dilution o Count colony forming units o Exercise using formula for calculating the cell number

Practical 7: Direct microscopic count	**3 h**
Objectives o enumerate of cells by direct microscopic count o perform back-calculation	*Content* o Preparation of suitable dilution o Preparation of slides for examination o Exercise on back-calculation
Practical 8: Determination of coliforms in milk	**4 h**
Objectives o use differential-cum-selective media (EMB agar, McConkey agar) o differentiate the organism based on diagnostic features	*Content* o Preparation sample (aseptic) o Preparation and plating of media o Aseptic inoculation o Expression of result
Practical 9: Identification of molds by tape culture	**4 h**
Objectives o study morphology different types of molds o become familiar with mold colonies o prepare tape culture	*Content* o Preparation of tape culture o Observation of morphology at 10×, 20×, and 40× objectives o Draw/take photographs of molds as seen in the microscope o Compare characteristics with standard figures for identification

Statistics and Mathematics

Credit hours: (6+2)/week
Total hours: 156 **Full Marks: 100**
Theory 117
Practical: 39

Course Description

This course is designed to provide the concept of elementary statistics. Course is intended to give knowledge on introduction to statistics, collection, classification and tabulation, diagrams and graphs, central tendency, measure of dispersion, correlation coefficient in elementary statistics.

Course Objectives

- Define statistics and point out the uses.
- Define collection, presentation, and interpretation of numerical data with their procedure
- Define collect present or interpret numerical data following approximate procedure.

Minimum Standards

Students must achieve a minimum of 40% accuracy in theory and 60% accuracy in practical.

Recommended Texts

1. A Text book of Statistics – B.C. Bajracharya
2. Elementary Statistics – H.C. Saxena
3. Statistical Methods – Mrigendralal Singh
4. Mahajan B.K. Method of Biostatistics

Course: Statistics and Mathematics	**Hrs. theory 117**
1. Collection and Organization of Data classification and Tabulation diagrams and graphs (Revision only)	**Hrs theory 11**
Objectives	Contents
1. Collect data (primary and secondary) 2. Classify and tabulate data. 3. Prepare frequency table (ungrouped and grouped form) 4. Represent data on simple, multiple, Sub divided, percentage bar diagram and pie diagrams.	• Data collection (Primary and secondary) • Classification and tabulation of data • Preparation of frequency table (ungrouped and grouped form) • Representation of data on simple, multiple, Sub divided, percentage bar diagram and pie diagrams • Representation of data on histogram, frequency

5. Represent data on histogram, frequency polygon, frequency curve and ogive curve	polygon, frequency curve and ogive curve
Evaluation methods: written exam, viva.	**Teaching /learning activities and resources:** classroom discussion, self study, application of process to given examples textbook.
2. Diagramatic and Graphic Presentation of Data	**Hrs theory 10**
Objectives	Contents
1. Represent the given data in different diagram and graph **2. Represent the given data in histogram, frequency polygon.** **3. Solve problem based on cumulative frequency and ogive curves.**	• Difference between diagrams and graphs. • Different types of diagrams, • Bar Diagrams: Simple, Multiple, Subdivided and Percentage; Pie diagrams. • Graphs of frequency distribution: Histogram, Frequency Polygon, Frequency curve, • Cumulative frequency curves (Ogives): less than and more than; Ogive curves in estimating percentiles, quartiles and median.
Evaluation methods: written exam, viva.	**Teaching /learning activities and resources:** classroom discussion, self study, application of process to given examples textbook.
3. Measure of Central tendency	**Hrs theory 11**
Objectives	Contents
1. Define central tendency 2. Calculate mean, median, mode, and partition values (Quartiles, Deciles and percentiles) for ungrouped and grouped data mathematically.	• Definition of central tendency • Calculation of mean, median, mode, and partition values (Quartiles, Deciles and percentiles) for ungrouped and grouped data mathematically
Evaluation methods: written exam, viva.	**Teaching /learning activities and resources:** classroom discussion, self study, application of process to given examples in textbook.
4. Measure of dispersion	**Hrs theory 11**
Objectives	Contents
1. Calculate range, mean deviation from mean, median and mode, quartile deviation and standard deviation for ungrouped and grouped data mathematically 2. Use Lorenz's curve to find the variability of two series	• Calculation of range, mean deviation from mean, median and mode, quartile deviation and standard deviation for ungrouped and grouped data mathematically. • Lorenz's curve to find the variability of two series. • Computation of coefficient of range, mean

3. Compute coefficient of range, mean deviation, quartile deviation, and variation for ungrouped and grouped data mathematically.	deviation, quartile deviation, and variation for ungrouped and grouped data mathematically.
Evaluation methods: written exam, viva.	**Teaching /learning activities and resources:** classroom discussion, self study, application of process to given examples in textbook.
5. Moments, Skewness and Kurtosis	**Hrs theory 11**
Objectives	Contents
1. Find the moment of given distribution **2. Compare skewness and kurtosis of given data.**	• 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.
Evaluation methods: written exam, viva.	**Teaching /learning activities and resources:** classroom discussion, self study, application of process to given examples in textbook.
6. Correlation and Regression	**Hrs theory 11**
Objectives	Contents
1. Define the concept of correlation. 2. Define correlation method by drawing Scatter diagram. 3. Explain Karl Pearson's coefficient of correlation between two variables.	• Concept of correlation. • Method of studying correlation by drawing Scatter diagram. • Calculations of Karl Pearson's coefficient of correlation between two variables.
Evaluation methods: written exam, viva.	**Teaching /learning activities and resources:** classroom discussion, self study, application of process to given examples in textbook.
7. Probability	**Hrs. theory 10**
Objectives	Contents
1. Define probability (classical and empirical) 2. Prove and use addition and multiplication theorem of probability. 3. Explain and use binomial probability distribution formula $P(r) = c(n, r)\, p^r q^{n-r}$	• Definition of probability (classical and empirical) • Proof and use addition and multiplication theorem of probability • Explanation and use binomial probability distribution formula $P(r) = c(n, r)\, p^r q^{n-r}$ • Exercise XVII (1) and (2) No.1 to 5 only from textbook of grade 11.

Evaluation methods: written assignments , written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical examples.
8. Concepts of Theoritical Probability Distribution	**Hrs. theory 11**
Objectives	Contents
1. Use the binomial distribution to solve the problem. **2. Expand the binomial expansion** **3. Find the general term of binomial expansion.** **4. Solve the simple problem of binomial expansion.**	• *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. • *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.)
Evaluation methods: written assignments , written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical examples.
9. Concepts of Norminal Curve and Normal Distribution	**Hrs. theory 9**
Objectives	Contents
1. Understand the normal distribution, standard variate and standard normal distribution 2. Solve the simple problem related to normal curve and standard normal variate.	• 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.
Evaluation methods: written assignments , written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical examples.

10. Elementary Idea of Sampling and Estimation	**Hrs. theory 11**
Objectives	Contents
1. Use the sampling. **2. Know the different types of sampling.** **3. Estimate the population from large sample.**	• *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. • *Introduction to Estimation*: Concepts of population, sample, parameter, statistics, estimator and estimates. Properties of a good estimator (introduction only). Estimating population from large sample, Point and Interval estimation. Estimation of $x \pm z_{\alpha} se(x)$
Evaluation methods: written assignments , written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical examples.
11. Elementary Idea of Test of Significance	**Hrs. theory 11**
Objectives	Contents
1. Test the normality test (z-test) of given data. **2. Use the t-test, χ^2-test from uniform distribution.**	• 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.
Evaluation methods: written assignments , written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical examples.

Practical skills

- Draw bar diagrams and pie chart. 4hrs
- Draw Histogram, frequency polygon, frequency curve and Ogive. 6hrs
- Compute mean, median, mode for grouped data. 4 hrs
- Compute quartile deviation, average deviation, standard deviation. 6 hrs
- Draw the curves and compute skewness of the data. 4 hrs
- Find out the relation between the variables (simple correlation and regression of two variables). 8 hrs
- Compute simple probabilities of events; (sum of events, compound events); Simple problems related to binomial theorem/Poisson distribution. 7 hrs

Principles of Fermentation Technology

Credit hours: 4+2 hours/week
Total hours: 117 **Full Marks: 75**
Theory:78
Practical: 39

Course description
The course explores exploitation of microorganisms for the production of industrial food products such as fermented foods and beverages. The course provides insight into desirable properties of industrially important microorganisms and their commercial and traditional uses for the production of a wide range of foods and beverages. At the conclusion, effluent treatment is also covered.

Course objectives

1. To deal with technology of fermented foods and beverages.
2. To discuss different types of fermentation processes and fermenters.
3. Provide skills on preservation and maintenance of industrially important cultures.

Text and reference books

1. Rai, B.K. (2012). Essentials of Industrial Microbiology. Lulu Publishing, USA
2. Bamforth, C.W. (2005). Food, fermentation and microorganisms. Blackwell Publishing. U.K.
3. McNeil, B. and Harvey, L.M. (2008). Practical Fermentation Technology. John Wiley & Sons. England
4. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2003). Principles of Fermentation Technology, 2nd Edition. Butterworth-Heinemann. London
5. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. (2001). Industrial Microbiology: An Introduction. Blackwell Science Ltd.
6. Okafor, N. (2007). Modern Industrial Microbiology and Biotechnology. Science Publishers. USA
7. Kharel, G., Acharya, P.P. and Rai, B.K. (2010). Traditional Foods of Nepal. Highland Publishers, Nepal.

THEORY

Course: Fermentation Technology	**Theory: 78 h Practical: 39 h**
Unit 1: Scope and importance of fermentation technology	**Th: 4 h**
Objectives ○ To give different definitions of fermentation ○ To familiarize with importance of fermentation technology	*Contents* ○ Importance of fermentation technology in food, feed, beverages, and pharmaceutical product manufacture. ○ Examples of different fermented products (wine, beer, kinema, gundruk, sauerkraut)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

Unit 2: Industrial application of microorganisms	**Th: 6 h**
Objectives o To prepare background for the subsequent chapters on specific fermentation o To discuss components of fermentation process (microorganism, substrate, and product/service)	*Contents* o Stoichiometry of fermentation o Desirable properties of microorganisms for fermentation o Discussion on use of microorganisms for food, feed, and beverage production
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 3: Concept of fermenter and fermentation	**Th: 15 h**
Objectives o To prepare additional background for the subsequent chapters on specific fermentation o To distinguish between different types of fermenters and fermentation processes o To study various components of a fermenter	*Contents* o Fermentation kinetics (Type-I, Type-II and Mixed Type) with relevant examples o Overview of Batch-, Continuous-, Submerged-, Fed-batch, Solid-state fermentation and examples o Relation of growth kinetics with product formation o Fermenter configuration (drawing and geometric ratios) o Description of component parts of fermentation process (upstream and downstream processing) o Component parts of a fermenter (impeller/agitator, baffles, heat exchange system, aeration system, sensors/probes)
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 4: Production of ethanol	**Th: 10 h**
Objectives o To study requirements for ethanol production (yeast, medium, fermenter) o To familiarize with upstream and downstream processing in microbial production of ethanol o To define relevant terms (degree proof, congeners, spirit)	*Contents* o Overview of the processes used for ethanol production from molasses o Batch fermentation process using blackstrap molasses as the substrate o Yeast culture and its maintenance o The distillation operation o Concept of congeneric and non-congeneric distillates o Proof and proof spirit o Industrial spirit
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 5: Production of beer	**Th: 11 h**
Objectives o To acquaint students with nature and nurture aspects of microorganisms o To study raw materials for beer production (water, yeast, malt, adjuncts, hops)	*Contents* o Definition, classification, and general composition o Description of raw materials (malt, hops, adjuncts, yeast, and water) o The malting process

○ To study lager beer fermentation, aging, bottling and pasteurization	○ Production of lager beer (major steps) ○ Technical terms used in brewery ○ Defects/spoilages of beer
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 6: Production of distilled spirits	**Th: 10 h**
Objectives ○ To impart knowledge on conversion of beverage spirit into various distilled alcoholic beverages ○ To study production of whisky, rum, brandy, vodka. ○ To study traditional raksi technology	*Content* ○ Whisky production (major steps) ○ Rum production (major steps) ○ Brandy production (major steps) ○ Vodka and gin production (major steps) ○ Raksi technology: Traditional production method, improvement options, and composition
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 7: Production of wine	**Th: 10 h**
Objectives ○ To study the basic principles of wine making ○ To classify wine (with examples) ○ To study methods for the production of different wine types (red wine, white wine, champagne)	*Content* ○ Definitions and classification of wine ○ Production of red table wine (major steps) ○ Production of white table wine (major steps) ○ Production of fortified wine (major steps for sherry) ○ Production of sparkling wine (the champagne process) ○ Defects/spoilages of wine
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 8: Fermented foods	**Th: 8 h**
Objectives ○ To impart knowledge on the technology and importance of traditional foods ○ To classify fermented foods (with examples)	*Content* ○ Definition, importance/advantages, classification ○ Traditional fermented foods and beverages (major steps for the production of sauerkraut, sake, kinema, sinki/gundruk, and jand)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 9: Effluent treatment	**Th: 4 h**
Objectives ○ To acquaint students with the importance of and methods used for treatment of waste generated from food industries ○ To carry calculations related to BOD and COD	*Content* ○ Introduction to waste treatment terminologies (Effluent, influent, BOD, COD) ○ Importance of effluent treatment ○ Types of effluent treatment systems (with emphasis on activated sludge-, trickling filter and lagoon process)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

PRACTICAL

Course: Fermentation Technology	**Practical: 39 h**
Practical 1: Screen fermentative yeasts from starter culture (murcha)	**5 h**
Objectives o To prepare enrichment culture o To carry out isolation of potential yeast cells from local starter o To carry out test-fermentation o To preserve the isolated yeast cells	*Contents* o Prepare enrichment culture o Microscopic examination o Spread-plate isolation of yeast o Test fermentation of yeast o Subculture of potential cells
Practical 2: Screen amylolytic molds from starter culture (murcha)	**5 h**
Objectives o To carry out spot culture o To obtain mold cultures of high potential from local starter o To carry out test-liquefaction o To preserve the isolated mold	*Content* o Growth of molds by planting murcha specks on media plate o Tape culture for examination o Test liquefaction in cooked rice o Subculture (by hypheal tip method) and storage of the molds with high amylolytic potential
Practical 3: Prepare red table wine	**5 h**
Objective o To acquaint students with the standard wine making process o To prepare must o To carry out red wine fermentation o To pasteurize and bottle red wine o To carry out sensory and physicochemical (alcohol content, acidity) tests	*Content* o Must treatment (sugar and acid adjustment) o Pitching rate calculation and pitching o Primary fermentation o After-fermentation o Pasteurization o Determination of alcohol content and acidity o Sensory analysis and statistical analysis of sensory data
Practical 4: Ethanol production from molasses	**5 h**
Objectives o Acquaint students with the standard ethanolic fermentation process	*Content* o Prepare molasses medium for fermentation (also conduct calculation drill) o Pitching rate calculation and pitching o Recording of fermentation rate (TSS trend)
Practical 5: Single column distillation and preparation of rum	**5 h**
Objectives o To acquaint the students with improved single column distillation system for the preparation of good quality rum o To study operation of single column distillation o To prepare rum for the distillate	*Content* o Separation of cuts o Collection of main cut (up to 50% abv) o Measurement/adjustment of alcohol content (using alcohol meter) o Preparation of caramel and applying the color o Bottling and labeling of rum
Practical 6: Preparation of beer	**5 h**
Objectives o To know basic steps of home beer making (lager type) o To carry out decoction mashing o To prepare lager beer	*Content* o Malt milling o Decoction mashing o Adjunct level calculation o Wort boiling and hopping

○ To carry out sensory and physicochemical (alcohol content, pH, acidity) analyses	○ Cooling, aeration and pitching ○ Fermentation ○ Sensory analysis (taste, smell, color, turbidity, alcohol content)
Practical 7: Preparation of sauerkraut	**4 h**
Objectives ○ To impart knowledge on lactic fermentation of vegetables ○ To prepare slaw ○ To follow the course of fermentation ○ To carry out sensory and chemical (pH, acidity) analyses	*Content* ○ Preparation of cabbage (coring, shredding) ○ Salt addition to prepare slaw ○ Fermentation ○ Sensory analysis (sourness, flavor, crispness) ○ Chemical analysis (acidity and pH)

Fourth Semester

Human Nutrition

Credit : 6+2hour/week
Total hours: 156 **Full Marks: 100**
Theory:117
Practical: 39

Course Description

This course is designed to give students the fundamental concept of human nutrition, nutrients and foods essential for human body. Emphasis is given to the principles related to foods and macro and micro nutrients required in every day for human life and to the application of human nutrition in Food Technology. An additional function of the course is to stimulate interest in the application of human nutrition and to prepare the student for further study in this field. A practical on different approaches on nutrition acquaints the student with use of related knowledge and skills to provide practical application of learned theory, which is relevant to food technology.

Course Objectives

Upon completion of the course the students will be able to:

1. Explain the basic concepts of food and nutrition.
2. Test the nutrients with proper procedures.
3. Apply the knowledge of human nutrition to analyze malnutrition and to improve nutritional status of people.
4. Utilize assessment principles in nutritional status testing.
5. Explain the use of food, balance diet properly during entire life cycle of human beings.
6. Apply the theoretical & practical knowledge of food and nutrition, which is basic requirement of human life.

Minimum Standards

Students must achieve a minimum of 20% accuracy in practical, 80% accuracy in theory.

Recommended Texts

1. Swaminathan M; Advanced Textbook on Food and Nutrition, Vol I and II, the Banglore printing and publishing Co. Ltd., India
2. Food and Nutrition Ghosh & Co. Current edition.
3. Gutrie HA, Picciano MF; Human Nutrition. New York

RefereceTexts:

1. Z.S.C. Okoye; Biochemical aspects of Nutrition, PHI pt. ltd., India
2. Bowman BA, Russel RM; Present knowledge in nutrition 8th edition ILSI 2001
3. Shils ME, et. al.; Modern nutrition in health and diseses, 9th edition, Philadelphia

Course: Human Nutrition	**Hrs. theory 117 Hrs. lab 39**
Unit 1: Fundamentals of Food and nutrition	**Theory:24Hrs.**
Objectives	Contents
1. Definition of human nutrition, food, food products and nutrients. 2. List the sources nutrients and their dietary sources. 3. Understand the major and essential nutrient. 4. Understand the energy requirement and Basal Metabolic Index (BMI) and effects of over nutrition.	• Introduction of nutrition, basic concept and principles of nutrition, the role of nutrition in human development, the importance of nutrition, human body composition and role of nutrition, description of food and nutrition, scope and fields of human nutrition, basic tools in the study of nutrition. • Dietary sources of nutrients and nutrient interrelationship. • Nutritive value of foods, macro and micro nutrients and their functions, Carbohydrates, proteins, lipids, minerals, vitamins, dietary fiber and water. • Essential amino acids, essential fatty acids. Significance of vitamins and minerals and other nutrients. • Energy value calculations of nutrients, total energy requirement (TER). Basal Metabolic Index (BMI) and its significance. • Anti-nutritional factors, nutrients loss, effects of food processing and preparation in different nutrients. • Description on over nutrition and obesity, disease of excessive intake of nutrients. Macro nutrient imbalance.
Evaluation methods: Written exam, oral and written assignments, performance observation in lab and individual exercises.	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, proximate analysis of nutrients (carbohydrates, fats, proteins, minerals and principles of analysis of some vitamins; Vit. A and C)) in food and individual exercises. Demonstration of assessment of nutritional condition and BMI.
nit 2: Bio-Chemical aspects of Nutrition	**Theory: 20 Hrs.**
Objectives Understand digestion, absorption and metabolism Understand Enzyme and Enzyme activity	Fundamentals of digestion, absorption and metabolism Enzyme, Enzyme kinetic, factors affecting Enzyme activity, Co-factors and co-enzyme digestion, absorption and metabolism of carbohydrate, protein and lipids. Concept of glycolysis, krebs cycle, electron transport chain and gluconeogenesis.

Unit 3: Malnutrition and Assessment of nutritional status	**Theory : 24Hrs.**
Objectives	Contents
1. Identify and explain the forms and types of malnutrition. 2. Understand the ways to assess malnutrition and their remedy. 3. Understand the balance and proper nutrition. 4. Understand the nutritional assessment and epidemiology disease condition.	• Definition of malnutrition forms of and types of malnutrition their consequence to human life. Double burden of malnutrition. Risk population groups on malnutrition. • Description and causes of malnutrition and methods to overcome the problem of malnutrition. • Significance of various nutrients on malnutrition. Description of balance diet. Recommended Daily Allowances (RDA), RDA for different class and working group of people. Concept of meal planning, Food balance sheet and food composition table. • Concept of poverty and malnutrition. Nutritional status of Nepalese people with respect to geography, ethnicity, age, sex, etc. Description of causes of malnutrition with example of UNICEF model. Overview on causes of malnutrition in Nepal. • Concept of nutritional assessment, nutritional assessment: definition, purpose and method. Growth chart of children and its importance • Concept of epidemiology and nutritional epidemiology. Measures of disease frequency: Morbidity measures: prevalent rate vs incidence rate. Mortality measures: crude birth rate, Infant mortality rate, maternal mortality rate. Health status of individual in relation to nutritional status.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities or resources :** Theoretical explanation, Classroom instruction exercises, Demonstration of assessment of nutritional status, anthropometric measurements.
Unit 4: Nutrition in the life stages and Food habit	**Hrs. theory 14**
Objectives	Contents
1. Understand the nutritional requirements in different stages of human life. 2. Understand food habit and human life style.	• Life cycle approach of nutrition, physiological groups, nutrients need and rationale. • Description of food habit in relation to nutrition. Socio economic structures, cultures, practices and food taboos and believes affecting nutrition.

3. Understand food habit to nutrition. 4. Understand the conventional practices and food taboos regarding food and nutrition. 5. Introduce food sensitivity.	• Current situation of food in Nepalese context. Socio economic structures, cultures, practices and taboos affecting nutrition. • Fundamentals of food sensitivity: food hypersensitivity, food allergy and intolerance.
Evaluation methods: written exam, oral and written assignments, group works and presentation	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, case study, Chart display.
Unit 5: Food and Nutrition Security	**Hrs. theory 8**
Objectives	*Contents*
1. Understand food security and food and nutrition security, food safety, food quality and food utilization in human body. 2. Understand the influencing factors for food utilization in human body.	• The concept of food and nutrition security, food safety and food quality with relation to human nutrition. Four pillars of food security • Food utilization in human body and factors influencing food utilization.
Evaluation methods: written exam, oral and written assignments, individual exercises.	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, and individual exercises.
Unit 6: Role of National and international agencies in Nutrition	**Hrs. theory 11**
Objectives	Contents
1. Understandthe role of national and international agencies.	• The role of different national and international organization in relation to human nutrition. Declaration on ICN, current national nutrition policies and programs of Nepal, role of UN agencies (UNICEF, FAO, WHO) and other related agencies. • Importance of Information, education and communication programmers on nutrition.
Evaluation methods: written exam, oral and written assignments, exercises.	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, group work and exercise.
Unit 7: Food supplementation and fortification	**Hrs. theory 12**
Objectives	Contents
1. Understand the concept of food supplementation and fortification 2. Understand the infant and weaning	• Fundamental principles of food supplementation, food fortification and food enrichment. Importance of food supplementation, food fortification and food enrichment.

food and importance of breast feeding.	Policy and laws on food fortification and food supplementation in Nepal. • Breast feeding and its significance. • Infant food and weaning food. • Prepare weaning food with different recipe. Importance of weaning food.
Unit 8: Nutritional labeling and claim.	**Hrs. theory 4**
Understand nutrition labeling and claim.	Principles of nutritional labeling and claim and its significance.
Evaluation methods: written exam, oral and written assignments, exercises, demonstrate in lab.	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, group work, exercise and practical works.

Human Nutrition Practical

Practical 1: Introduction and proximate analysis of nutrients from food	Hrs. lab 12
Objectives	*Contents*
1. Follow stated laboratory procedures and guidelines for macro nutrients analysis. 2. Demonstrate the methods for proximate analysis of nutrients;	• Procedural rules and guidelines of the nutrition lab. • Study on food composition table. • Study on RDA to different age group. • Calculation of energy value of nutrients. • Determination of Basal metabolic Index (BMI) of classmates, friends and teachers.
Evaluation methods: Written and viva exams, performance observation in laboratory settings and analysis results.	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory analysis practice.

Practical 2 Nutritional assessment	**Hrs. lab 10**
Objectives	*Contents*
1. Describe to measure nutritional assessment with methods: • Direct • Indirect	• The direct anthropometry measurement method to assess nutritional assessment. • The indirect dietary study method to assess nutritional assessment i.e. Individual exercise on basic tools in the study of nutrition (determine own desirable body weight, DBW; estimate total energy requirement, TER based on DBW, compute for energy and protein intake based on one 24 food recall, determine one day energy and protein adequacy level) • Demonstrate and present other direct and indirect nutritional assessment methods.
Evaluation methods: Written and viva exams, performance observation of measurement, presentation.	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice and presentation, problem solving.
Practical 3. Food supplementation and fortification	**Hrs. lab 8**
Objectives	*Contents*
1. Measurement and observation of iodine fortification in salt and iron fortification in wheat flour. 2. Collection of different recipe of weaning food preparation and preparation of weaning food in the lab.	• Qualitative and quantitative measurement of iodine in salt and iron in wheat flour and interpretation of obtained result as per regulatory requirement. • Collection of different recipe of weaning food preparation and preparation of weaning food in the lab.
1. Preparation and presentation of list of allergic foods and other food ingredients which can cause hypersensitivity.	Preparation of chart on allergic foods and other food ingredients which can cause hypersensitivity.

Practical 4. Food Labeling and Claim	**Hrs. lab 3**
Study on food labeling	The observation of nutritional label and claim of different food materials available in market
Evaluation methods: Written and viva exams, performance observation in laboratory settings and analysis results. Chart preparation and presentation.	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice, preparation and presentation.
Practical 5: Qualitative test of carbohydrate and protein	**Hrs. lab 6**
	Molish test, test of glucose, fructose and starch test Ninhydrin test

Computer Application

Credit hours: (2+4)/week
Total hours: 117 **Full Marks: 75**
Theory:39
Practical: 78

Course Description

This course provides computer application in Food and Dairy Technology. Course is intended to give knowledge on hardware requirements of computer, Operating Systems, Word processing, spreadsheet and database, presentation, graphic and multimedia, Web, Email and Internet, Virus and anti-virus definitions, Geographic Information System (GIS) and its application.

Course Objectives

- Gain knowledge and skills on computer application and GIS application
- Able to prepare word documents
- Able to do preliminary calculations and analysis in spreadsheet
- Able to prepare graphics and presentation slides
- Able to work on GIS domain for the application of forestry and natural resource management

Minimum Standards

Students must achieve a minimum of 40% accuracy in theory and 60% accuracy in practical.

Recommended Texts

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.
8. Mahajan B.K. Method of Biostatistics
9. Fundamentals of Geographic Information System – Michael E. Demers
10. GIS for Beginners – ICIMOD
11. Introduction to ArcView GIS – ESRI
12. Getting to know ArcView GIS – ESRI
13. Principles of GIS – Peter A. Burrough and Rachael A. McDonnell

Course: Computer application	**Hrs. theory 39 Hrs. Practical 78**
1. Introduction to computer	**Hrs. theory 2**
Objectives	Content

1. Explain about the generation of computers.
2. List hardware and peripherals of computer
3. List the available software in general use.
4. Write about memory and data storage in computer
5. Discuss about operating system in computer
	• Evolution of computer
	• Introduction to computing and computers
	• History of computers
	• Generation of computers
	• Types of computer(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
	• Hardware: CPU, Monitor, Input and output peripherals
	• Software: systems, applications and utility software
	• Memory: RAM, ROM, storage systems, storage types and Data storage
	• Operating Systems: DOS, Windows, Linux, Nepalinux
	• Terminologies

1. Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	• Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
Computer System	***Hrs. theory 3***
Objectives	Content
1. Get idea about different types of hardware. 2. Handle different application like m/s word, excel, power point.	○ 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.
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books

Computer Operating Systems	**Hrs. theory 3**
Objectives	Content
1. Handle different operating system. 2. Create and manage file and folder.	○ 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.
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
3. Word Processing	**Hrs. theory 2**
Objectives	Content
1. Create word document in computer. 2. Format the document 3. Edit the document 4. Print the final document	• Document creation • Formatting, proof reading, editing • Typing Tutor • Saving and opening • Printing
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
Unit 3 Spreadsheet	**Hrs. theory 5**
Objectives	Content
1. Prepare a schema of data tabulation 2. Enter data in	• Data tabulation • Data entry • Formatting, editing, charting calculations, formulas

spreadsheet 3. Format the excel sheet 4. Do calculation using formula in spreadsheet 5. Prepare charts based on entered data	• Saving and opening • Presentation and printing
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
4. Database Package	**Hrs. theory 7**
Objectives	Content
Know creation of data base in m/s, access table, shorting, replacing and listing fields and report generation.	Creating database, sorting, replacing and listing fields. Report formatting, Screen formatting for data entering.
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
5. Presentation and Graphics	**Hrs. theory 5**
Objectives	Content
1. Prepare slides for presentation 2. Apply different design schemes in slides 3. Apply different animations for the objects 4. Edit the slides 5. Go to slide show	• Slide preparation • Design, multimedia, proofreading, editing • Saving and Opening • Presentation and printing
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books

6. Email, Internet, Virus protection	**Hrs. theory 5**
Objectives	Content
1. Explain about Email 2. Explain about Internet 3. Explain about website 4. Explain about virus and anti-virus system	• System of Email • Internet, URL, WWW, http • Installation of application software • Concept of networking environment • Virus and virus protection mechanism: Norton, SVG… • Maintaining the Computer System • Use of proper utility to recover the damaged files in diskette and hard disk • Installation of Application Software • Application of Computer Skills in Dairy/Food Industries.
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
8. Introduction to GIS	***Hrs. theory 7***
Objectives	Content
1. Define GIS. 2. Answer "What GIS can answer" 3. List the components of GIS 4. Define GIS terminologies. 5. List the types of GIS	• Define GIS • Scope and importance of GIS • Components of GIS • GIS terminologies • Use of maps • Map reading • GIS software • Types of GIS
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books

Practical skills : Hrs. Practical 78

- Identify/connect the computer/peripheral devices 2 hrs
- Install the operating system 2 hrs
- Apply/Use the operating system 7 hrs
- Install the application software 2 hrs
- Prepare a document in word processor 10 hrs
- Prepare spreadsheet 10 hrs
- Create presentations 5 hrs
- Create database /Manage database 10 hrs
- Work with internet/Work with e-mail 5 hrs
- Work in the networking environment 10 hrs
- Maintain the computer system 10 hrs
- Apply computer skills in Dairy/Food technology/industries 5 hrs
- Perform practical skills as many times as possible to develop confidence/expertise

Milk and Milk Products

Credit hours: 4+2 hours/week
Total hours: 117 **Full Marks: 75**
Theory:78
Practical: 39

Course description

The course provides knowledge on milk secretion, composition, quality, and preparation of milk products with scientific background. For the product range, the course covers market milk, frozen desserts, cheese, fermented milks, butter, ghee and sweetmeats. The course concludes with hygiene and sanitation.

Course objectives

1. To compare composition of milk from different animals.
2. To discuss product technology of a range of milk products.
3. To give knowledge on the highly perishable nature of milk and thus the importance of microbial quality of milk.

Text and reference books

1. Bylund, C. (2003). Dairy Processing Handbook, 2nd Edition. Tetrapak Processing Systems AB, Sweden
2. Adhikari, R.P. and Bhandari, C. (2005). Production Technology of Dairy Products (Nepali version). Janajyoti Pustak Pasal, Kathmandu, Nepal.
3. Behare, P., Minz, P.S., Mandal, S., Kumar, S. and Cichudde, D.A. (2013). Fluid milk Processing: Student Handbook for Class XI. CBSE, Delhi
4. FAO. (2010). Dairy Sector Study of Nepal, FAO
5. Goff, D. (??). Dairy Science and Technology (education series)., University of Guelph
6. Ebing, P. and Rutgers, K. (2006). Preparation of Dairy Products (Agrodok 36). Agromisa Foundation and CTA, Wageningen
7. Varnam, A.H. and Sutherland, J.P. (1994). Milk and Milk Products: Technology, Chemistry and Microbiology. Chapman & Hall, London.

THEORY

Course: Milk and milk products	**Theory: 78 h Practical: 39 h**
Unit 1: Milk	**Th: 6 h**
Objectives ○ To provide background for milk composition and quality ○ To study gross composition of different milks (cow, buffalo, yak, human)	*Contents* ○ Definition, gross composition and comparison (cow, buffalo, human) ○ Milk quality (platform- and payment tests, milk grading)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

Unit 2: Milk secretion and ejection	**Th: 8 h**
Objective ○ To know mechanisms of milk secretion and ejection ○ To study factors affecting milk composition and yield	○ Overview of milk secretion in alveoli ○ Ejection reflexes (inward and outward) ○ Factors affecting milk yield (genetic and environmental)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 3: Milk microbiology	**Th: 9 h**
Objectives ○ To give idea about normal flora, index organisms and contaminants. ○ To give knowledge on starter cultures	*Contents* ○ Normal flora (profile) ○ Pathogens and contaminants ○ Index organism of pasteurization adequacy ○ Starter cultures for fermented milk (types and description)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 4: Market milk	**Th: 10 h**
Objectives ○ To familiarize with a range of fluid milk available in the market for sale ○ To study heat stabilization of milk ○ To study manufacture of special milks (flavored, reconstituted, recombined, homogenized)	*Contents* ○ Definition, principle, classification ○ Pasteurized milk (definition, standards, production flow diagram, classification) ○ Standardization of milk and its purpose ○ UHT milk (production flow diagram and description) ○ Sterilized milk (production flow diagram and description) ○ Special milks (definition, types, description and purpose, production flow diagram for reconstituted-, flavored-, and recombined milk)
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 5: Frozen desserts	**Th: 8 h**
Objectives ○ To acquaint with technology of frozen desserts with emphasis on ice cream ○ To study ingredients and functions of ice cream ○ To learn mix calculation ○ To study production of soft-serve and hardened ice cream	*Contents* ○ Definition and classification ○ Ice cream ingredients and their functions ○ Production flow diagram of standard (regular) ice cream ○ Exercise on mix calculation ○ Ice cream defects
Evaluation ○ Oral and written tests, home assignment	*Teaching methods or materials* ○ Classroom instruction, textbooks, reference books, charts, diagrams, video clips

Unit 6: Cheese	**Th: 10 h**
Objectives o To impart knowledge on technology of cheese and related products o To study production of cheddar and mozzarella cheese o To study production chhurpi o To study cheese additives (starter culture, rennet, color, salt)	*Content* o Definition, classification with examples o Principles of cheese making o Quality of milk for cheese making o Cheese additives o Production flow diagram for kanchan-, mozzarella, and cheddar cheese o Churpi and its production o Paneer and chhana (definition, differences, production and uses) o Cheese defects
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 7: Fermented milks	**Th: 10 h**
Objectives o To familiarize with product range, production technology, and nutritional value o To study production of yogurt and related products (dahi, jujudhau)	*Content* o Definition, classification, importance o Yogurt (definition, classification with examples, yogurt cultures, production flow diagram of plain- and fruit yhogurt o General defects in yogurt o Dahi and related products (general description of regular dahi, mishti doi, jujudhau, etc.) o
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 8: Butter and related products	**Th: 9 h**
Objectives o To impart knowledge on butter and related products and their production technology o To study production of salted and unsalted butter o To study production of ghee	*Content* o Definition and types, standards o Principles of butter making o Production flow diagram for plain-, cultured/ripened-, and salted butter o Nauni (deshi ghee) (general description and production flow diagram o Ghee (butteriol) (definition and standard) o Ghee production methods (classification and general flow diagram)
Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 9: Dairy based sweetmeats	**Th: 5 h**
Objectives o Students will learn value addition of milk by gaining knowledge on sweetmeat production o To study production of rasogolla and khoa	*Content* o Definition of sweetmeat, importance (value addition, preservation, cultural aspects, etc.) with examples o Production flow diagram of lollipop, and rasogolla (rasbari)

Evaluation o Oral and written tests, home assignment	*Teaching methods or materials* o Classroom instruction, textbooks, reference books, charts, diagrams, video clips
Unit 10: Hygiene and sanitation in dairy	**Th: 3 h**
Objectives o Acquaint with importance and method of performing sanitation and hygiene in dairy industry o To study the CIP process	*Content* o Importance of sanitation and hygiene in dairy industry o General principles of sanitation and hygiene o Hot and cold components o Cleaning in Place (CIP) o Centralized CIP

PRACTICAL

Course: Milk and milk products	**Practical: 39 h**
Practical 1: Lab test of raw and pasteurized milk	**7 h**
Objectives o To determine sensory quality of milk o To determine fat and SNF (payment test)	*Contents* o Platform test for raw milk o Fat and SNF determination
Practical 2: Perform batch pasteurization of milk	**5 h**
Objectives o To carry out batch pasteurization of milk o To test the adequacy of pasteurization by phosphatase test	*Content* o Batch pasteurization o Phosphatase test for adequacy of pasteurization
Practical 3: Prepare ice cream	**8 h**
Objectives o To carry out mix calculation o To operate ice cream freezer o To prepare standard (regular) soft serve and hard ice cream o To calculate over run of ice cream	*Content* o Carry out mix calculation o Carry out pasteurization and aging of mix Use traditional bucket freezer (electrically powered) to prepare ice cream o Calculate overrun o Calculate production cost
Practical 4: Prepare chhana and paneer	**5 h**
Objectives o To study precipitation of casein by pH alteration o To prepare chhana/paneer o To calculate yield	*Content* o Pretreatment of milk (heating to prescribed temperature) o Calculation of amount of acidulant o Preparation of chhana o Preparation of paneer o Calculation yield (50% moisture basis) o Production cost calculation
Practical 5: Preparation of rasogolla	**5 h**
Objectives o To prepare chhana as the raw material for rasbari/rasogolla o To prepare rasbari o To calculate yield o To carry out sensory analysis	*Content* o Preparation of chhana o Calculation of amount of sugar needed o Preparation of rasogolla balls and cooking in sugar syrup o Cooling and storage o Calculation of yield (balls per kg of milk)

	○ Production cost calculation ○ Sensory analysis
Practical 6: Preparation flavored milk	**4 h**
Objectives ○ To formulate flavored milk ○ To prepare flavored milk by batch sterilization method ○ To carry out sensory analysis	*Content* ○ Formulation of the milk ○ Mixing of the ingredients ○ Bottling and sterilization ○ Sensory analysis
Practical 7: Preparation of yogurt	**5 h**
Objective ○ To prepare starter culture ○ To adjust composition of milk (fat and SNF) for yogurt preparation ○ To prepare yogurt ○ To carry out sensory and physicochemical analyses (pH, acidity, syneresis)	*Content* ○ Standardization of milk for yogurt preparation (SNF not less than 8.5) ○ Heating for prescribed time-temperature regime ○ Cooling to 45°C and inoculation with 2% thermophilic standard starter culture ○ Incubation for setting yogurt ○ Analysis of physical and sensory defects

Food Chemistry

Total hours: 117 **Full Marks: 75**
Theory:78
Practical: 39

Course description:

The course in Food Chemistry is designed to provide student knowledge on the components of foods, their structure, properties, their effect and changes during preparation, processing and storage of foods. The course covers various areas such as major components of food like moisture, carbohydrates, proteins, fats/oils, vitamins and minerals and also food additives and browning in foods.

Course objective:

Upon completion of the course the students will be able to understand:

- Concept of the proximate composition of foods ,their functions and determination
- Pectin and their importance
- Food additives and their applications in foods
- Browning reactions which brings some desirable and undesirable colour and flavor changes during processing and storage of foods.

Minimum Standard

Students must achieve a minimum of 60 % in practical examination and 40% of full marks in the theory

References:

1. Basic Food chemistry, Mayer
2. Fundamental biochemistry , J L Jain
3. Essential of food chemistry, JBKC and BK Rai
4. Chemistry of oils and fats, rank D. Gunstone, CRC press.

Course: Food Chemistry	**Theory: 78 h** **Practical: 39 hrs**
Unit 1: Composition of foods	**Theory: 3h**
Objectives	**Contents**
Understand the composition of food and their importance	-Introduction of Food Chemistry -Composition of foods and importance

Evaluation: Oral and written tests, home assignments.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, food composition table.
Unit 2: Moisture in foods	**Theory: 6 h**
Objectives	**Contents**
1. Understand concept of moisture in food 2. Understand the structure and types of water and hydrogen bonding 3. Understand the moisture determination methods and their application in different foods	• Introduction and importance of moisture in foods • Structure of water and hydrogen bonding • Methods of moisture determination: a) Drying methods e.g., Hot air oven, vacuum oven, infrared drying b) Distillation method eg, immiscible solvent distillation method c) Chemical methods d) Physical methods e.g., hydrometer, lactometer, electrical moisture meters
Evaluation: Oral and written tests, home assignment.	**Teaching Methods:** Classroom instruction, Class room demonstration, textbooks, reference books, , photographs
Unit 3: Carbohydrates	**Theory:16 h**
Objectives	Contents
1. Concept of carbohydrates and its functions 2. Understand classification 3. Understand Concept of monosaccharide, disaccharides, reducing and non-reducing sugars, polysaccharides	• Definition and functions of carbohydrates • Classification of carbohydrates • Introduction, sources, structure and uses of glucose and fructose. • Introduction, sources, structure and uses of sucrose and lactose; manufacture of sucrose • Difference between reducing and non –reducing sugars • Definition, types of polysaccharides; sources, components and uses of starch; and introduction to pectin.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, diagrams, photographs. Audio-visuals

Unit 4 Crude fibre	**Theory: 4 h**
Objectives	Contents
Understand the crude fibre and dietary fibres	Introduction definition of crude fibre and dietary fibre; types and functions of dietary fibre the effects of excessive dietary fibre in diet, determination of crude fibre.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books,
Unit 5 Pectin	**Theory: 2 h**
Objectives	Contents
Understand pectin and its applications	Introduction, sources, structure, pectin grade, extraction, and uses of pectin.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books,
Unit 6 Proteins	**Theory: 8 hrs**
Objectives	Contents
1. Understand of protein ad their functions in human being 2. Understand of amino acids 3. Understand the classification of proteins 4. Understand of denaturation of proteins 5. Understand of protein determination	• Introduction, important functions of proteins • Introduction to amino acids, nutritional classification of amino acids • Classification of proteins: shape, size and composition and nutritional. • Protein denaturation : effects, denaturing agents and types of denaturation • Methods of protein determination: Kjeldahl method, Formol titration method and other chemical and physical method(name only)
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books,
Unit 7:Chemistry of fats and oils	**10 h**
Objectives	Content
Understand the chemistry of fats and oils and identify the fats and oils	Definition and importance of fats and oils, their composition, fatty acids: types of fats and oils; important physical and chemical properties of fats and oils; identification of natural fats and oils(sp gr, refractive Index, melting point, some values/numbers e.g., AV, SV, IV, PV)

Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books,.
Unit 8:Vitamins	**5 h**
Objectives	Content
1. Understand vitamins :types, importance 2. Understand fat soluble vitamins 3. Understand water soluble vitamins	• Definition, importance and types of vitamins • Fat soluble vitamins: functions, sources and deficiency diseases associated mainly to vitamin A and D. • Water soluble vitamins: functions, sources and deficiency diseases associated to specially vitamin B_1, B_2, B_5, B_7 and B_{12} and vitamin C.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, photographs.
Unit 9: Minerals	**5 h**
Objectives	Content
1. Understand functions of minerals 2. Understand the major and trace elements 3. Study the important minerals 4. Understand the method of determination	• Biochemical functions of minerals, major and trace(microelements). • Important minerals like Ca, P4, Fe, I_2 • Method of determination of Ca and Fe.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, , photographs.
Unit 10 : food additives	**13h**
Objectives	**Content**
1. Understand the food additives 2. Understand characteristics, functions and uses	• Definition, types and importance • natural colors (carotenoids, anthocyanins, chlorophyll), stabilizers, emulsifiers, artificial sweeteners (saccharin), antioxidants, preservatives (benzoic acid, SO_2), flavor(in brief)
Evaluation Oral and written tests, home assignment	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, , photographs.
Unit 11:Browning in foods	**6hrs**
Objectives	Content
1. Understand browning, types	• Definition, desirable and undesirable aspect of

2. Understand the non-enzymic browning and factors influencing and prevention 3. Understand the enzymic browning, mechanism and prevention	browning, types of browning • Non-enzymic browning: Maillard reaction, Caramelization and Ascorbic acid oxidation(in brief) • Enzymic browning: Occurrence. mechanism and prevention
Evaluation Oral and written tests, home assignment	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, , photographs.

Practical

Practical	**Teaching hours**
1. Determination of proximate composition of food items	**15**
2. Determination of reducing/non-reducing sugars	**6**
3. Determination of FFA, peroxide value, refractive index of fat/oil	**6**
4. Determination of SO_2	**3**
5. Determination of benzoic acid	**3**
6. Determination of iron and calcium in food items	**4**
7. Determination of Vitamin C	**2**

Technology of Food Products (Cereal Technology)-I

Credit Hour: 3+3=6 hours per week

Total hours: 117 **Full Marks: 100**

Theory: 59

Practical: 58

Course Description

This course deals post-harvest handling and basic knowledge of cereal processing and utilization of major cereal grain and their products. It also deals with the major cereal grain which effect the milling yield. Primarily, it imparts the basic knowledge about the grain milling and also provides the knowledge of preparation of different quality cereal products.

Objectives of the course

1. To provide the knowledge of post-harvest handling of major cereal grain
2. To impart the knowledge about the physical properties of grain which effect the milling yield
3. To teach the basic milling technology of wheat and rice
4. To deliver the skill about the preparation of wheat flour products
5. To discuss the nutritional aspects of wheat, rice and their improvement

Text and Reference Books

1. Kent N. L. and Evers A. D (2004). *Kent's Technology of cereal of Cereals*. Woodhead Publishing: England.
2. Sahay K. M. and Singh K. K. (2001). *Limit Operations of Agricultural Processing*. Vikas Publishing House, India.
3. Chakraverty . A. (2000). *Post-harvest Technology of Cereals, Pulses and Oilseed*. Oxford & IBH Publishing: Calcutta, India.
4. Bandyopadhyaya, S. and Roy, N. C. (1992). *Rice Process Technology*. Oxford & IBH Publishing, India.

Course: Technology of Food Product (TFP-1)	**Theory : 59 hrs Practical: 58 hrs**
Theory	**59 hrs**
Unit 1. Harvesting and handling of major cereal grains	**Th : 18hrs**
Objective • Provide the basic knowledge of post-harvest handling of rice, wheat and maize.	**Contents** • Introduction and distribution of important cereal grains: Rice, wheat and maize. • Post-harvest handling of wheat paddy and maize. • Physical properties of cereal grains. 1. Bulk density, density specific gravity.

	2. 1000 kernels weight. 3. l,b,t, l/b ratio • Structure and chemical composition of rice, wheat and maize.
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 2: Milling of Cereal Grain	**Th: 20hrs**
Objective • Provide the knowledge of rice wheat milling	**Contents** • wheat milling – cleaning, hydro thermal treatment, burr milling, hammer milling and roller milling system, atta, maida and their quality • Rice milling: cleaning, engleberg milling, huller milling and sheller milling system, paddy separation, whitening, grading • Parboiling of rice and its benefits. • Utilization of by products: husk, bran and grain
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 3: Technology of cereal products	**Th: 20hrs**
Objective • Impart the knowledge on technology of bread, biscuit, noodles, and breakfast cereal	**Contents** • Production of bread, biscuits, raw materials, processing methods quality and packaging. • Noodles: Raw materials, processing methods, quality criteria, instant noodles, quality of products and packaging. • Production of breakfast cereal corn flakes, beaten rice, puffed rice.
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.

PRACTICAL

Course: Technology of food products 1	**Practical: 59hrs**
Practical 1: Evaluation of physical property of grain	**8hrs**
Objective • Acquire the knowledge of physical property of grain	**Contents** • Determination of dimensional properties of rice, wheat and maize • Determination of gravimetric properties of rice, wheat and maize
Practical 2: Study structure of grain	**9hrs**
Objective • Give the knowledge about the anatomy and chemical composition of grain	**Contents** • Structure of rice, wheat, and maize. • Chemical composition of rice, wheat, and maize
Practical 3: Milling and grading of grain	**6hrs**
Objective • Give the basis knowledge of rice and wheat milling and grading of rice	**Contents** • Carry out the milling of rice and wheat • Grading of rice grain and wheat flour.
Practical 4: Gluten determination of wheat flour	**3hrs**
Objective • Give the basic knowledge of strength of gluten	**Contents** • Determine the gluten of wheat flour.
Practical 5: Preparation of wheat flour products	**15hrs**
Objective • Give the knowledge of utilization of wheat flour and it value addition	**Contents** • Preparation of bread and quality evaluation • Preparation of biscuits and quality evaluation.
Practical 6: Preparation of noodles	**8hrs**
Objective • Acquire the knowledge of noodles preparation and its quality evaluation	**Contents** • Preparation of noodles and evaluate the quality.
Practical 7: Industrial visit	**9hrs**
Objective • Gain the knowledge of different product in industries	**Contents** • Carry out industrial visit. • Summit the report of industrial visit

Food Engineering

Total hours: 156 **Full Marks: 100**
Theory: 98
Practical:58

Course description:

The course in Food Engineering is designed to provide student knowledge on the fundamental principles of engineering applied in the subject area of food science and in industries related to food processing. The course covers various areas food engineering such as various unit operations, transfer process, boiler and its operation.

Course objective:
Upon completion of the course the students will be able to understand:

- Concept of unit operations: mass balance and heat balance
- Fluid flow
- Heat transfer
- Drying and evaporation
- Process of distillation and crystallization
- Size reduction
- Boilers

Recommended Texts

6 Christie J. Geankoplis, Transport Process and Unit operations, Prentice-Hall International, Inc.
7 R Paul Singh, Dennis R. Heldman, Introduction to Food Engineering, Food Science and Technology International Series
8 Toledo, Romeo T, Fundamentals of Food Process Engineering, Third edition, Springer publication

Course: Food Engineering	**Theory: 98 hrs Practical: 58 hrs.**
Unit 1: Unit, Dimension and their conversion	**Theory: 3 hrs**
Objectives	Contents
Understand the Concept of Units and Dimension and conversion concept	Unit, dimension and their conversion with special reference to SI system
Evaluation: Oral and written tests, home assignments.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams
Unit 2: Mass and energy balance	
Objectives	**Theory: 6h**

Understand the concept of mass and energy balance	Law of conservation of mass, overall mass balance and component balance, law of conservation of energy, sensible heat, enthalpy, latent heat, simple exercises on mass and energy balance
Unit 2: Fluid Flow	**Theory: 16 h**
Objectives	**Contents**
1. Understand concept of Fluid flow, 2. Understand the viscosity and its implications 3. Understand the implications of laminar and turbulent flow	Fluid flow, Concept of viscosity, Concept of pressure and fluid pressure, Pressure measurement using manometers, Reynold's number and type of flow: laminar and turbulent, Poiseuille's equation, Bernoulli's law, head loss due to friction, pump power calculation, flow meters (venturimeter, orificemeter, rotameter, pitot tube)
Evaluation: Oral and written tests, home assignment.	**Teaching Methods:** Classroom instruction, Class room demonstration, textbooks, reference books, charts, diagrams, photographs
Unit 3: Heat transfer	**Theory:18 h**
Objectives	Contents
Understand various modes and mechanism of heat transfer	Specific heat capacity, Thermal conductivity Various modes of heat transfer, Fourrier's law of heat transfer, heat transfer through a slab and a cylinder, heat transfer through multilayer slab and cylinder, Convective heat transfer coefficient, overall heat transfer coefficient, counter current and co-current heat transfer, LMTD, related exercises, Radiation heat transfer, Tubular and plate heat exchanger
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs. Audio-visuals
Unit 4 Drying	**Theory: 14 h**
Objectives	**Contents**
Learn dry basis and wet basis moisture and their interconversion	Concept of drying, Mass balance, dry and wet basis moisture, relative humidity, water activity and equilibrium moisture content, Drying mechanism, drying curve: constant rate and falling rate period, critical moisture content, drying time calculation, Production of milk powder, production of dried vegetables, Various types of dryers: solar dryer, cabinet dryer, tunnel

	dryer, spray dryer and their industrial applications
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, and audio-visuals
Unit 5 Evaporation	**Theory: 11 h**
Objectives	Contents
1. Learn difference between drying and evaporation 2. Explain Boiling point elevation in the context of evaporation 3. Learn about the evaporation machineries	Introduction, Boiling point elevation, amount of steam needed to achieve evaporation, Climbing and falling film evaporators, Single effect and multiple effect evaporator, Production of fruit concentrates, condensed milk
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books, charts, diagrams, photographs audio visuals
Unit 6 Distillation	**Theory: 10hrs.**
Objectives	Contents
Learn working principles and application of various types of pumps used on food and dairy industries	Introduction to distillation, Rault's law, Boiling point diagram of binary mixture, Batch distillation, Rectification: rectification column, working principle of rectification process,Production of rectified spirit
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, audio visuals
Unit 7:Crystallization	**8 h**
Objectives	Content
Understand the theory behind the crystallization and its machineries	Unsaturated, saturated and Supersaturated solutions, solubility curve, Basic principle of crystallization: nucleation and crystal growth, factors affecting crystal growth, working principle of Crystallizer machine (vacuum crystallizer), Industrial applications of crystallization
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.

Unit 8: Separation techniques	**12 h**
Objectives	Content
Understand the principle behind separation techniques	Sedimentation: Terminal velocity, drag coefficient free and hindered settling Centrifugation: Centrifugal separation, working principle of centrifugal separator with an example of cream separator Filtration: Theory of constant rate and constant pressure filtration, plate and frame filter press, rotary vacuum filter
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.

Practical

Practical	**58h**
Simple mass and energy balance exercise	6
Observation of flow patter (laminar or turbulent) and calculation of Reynold's number	3
Measurement of viscosity, concentration effects of viscosity	12
Exercise to find number of theoretical plate in a rectification column	7
Fruit or vegetable drying and make a drying curve	6
Layout drawing (laboratory/ pilot plant)	6
Boiling point elevation	6
Report on industrial visit (observation for boilers, heat exchangers, pumps, plate and frame filtration system etc)	12

Fifth Semester

Food Safety and Quality Control

Total hours: 117 **Full Marks: 75**
Theory: 78
Practical: 39

Course Description

This course provides basic knowledge in relation to food quality and safety. It is very important to evaluate quality by detection of food adulterants and analysis of risk for quality assurance. It explains different terms such as food hazards, risk, quality control & assurance; adulterations, standardization and basic management tool like GHP, GMP, HACCP, ISO practices in Nepal and analysis techniques to ensure food safety that have been discussed in brief. This unit also introduces existing legal standards with respect to food and feed, standards (SPS & TBT) provision and other associated factors that influence food quality and public health. Both the theory and practical knowledge of technology help the students to develop more confidence.

Course Objectives

It is aimed to deliver broad objective to make students capable to knowledge & skill on food safety and quality control in order to carry out good manufacturing practices farm to industry level for assurance.
The specific objectives are as follows:-

- To give basic introduction to food safety
- To understand the concept of regulatory framework of Nepal (Food law, Food Regulation and Feed law)
- Sensory attributes of foods
- Adulteration, identification and corrective action
- To familiarize with the prerequisite of HACCP
- To conceptualize basic fundamentals of quality management system
- To study the trends of food chain and market situation in Nepalese
- Upon completion of this course, students are able to work in food industries and also capable to conduct their own small scale food business

Text books:

1. Jerry Banks, Principle of Quality Control, Wiley Johan, Wiley and Sons, New York
2. Food Quality Assurance: Principles and Practices,
3. Food Industry and Quality Control, Mark Clue, CRC Press
4. Sensory Shelf Life Estimation of Food Products, Guillermo Hough, 2010 by CRC Press , 63 B/W Illustrations, ISBN 9781420092912 – CAT
5. Quality Assurance for the Food Industry: A Practical Approach, J. Andres Vasconcelos, 2003 by CRC Press, 59 B/W Illustrations, ISBN 9780849319129 - CAT
6. Food Safety Management Programs, Application, best practices and compliances, Bebby Newslow, 2013 by CRC Press,389 Pages - 26 B/W Illustrations, ISBN 9781439826799 – CAT

Course: Food Safety and Quality Control	**Hrs. Theory: 78 , Hrs. Practical : 39**
Unit 1 : Fundamentals of food safety, quality control and assurance	Theory Time Hours
Understand quality, Quality control, quality Assurance and food safety	Content 10 hours • Definition of quality • Difference of quality control and assurance • Concept of food safety • Definition of hazards and their types • Differences between hazard and risk
Unit 2 : Quality Attributes of food	Theory Time 6 Hours
Objective • To know the quality attributes and sensory evaluation of foods	• Introduction to Quality attributes of foods • Introduction to Sensory evaluation of food, its benefits in food testing • Sensory attributes of foods: Colour, flavor, texture, tastes etc • Sensory evaluation tools and techniques
Unit 3: Food adulteration and detection	Theory Time 4 Hours
Objectives • To understand about food adulteration and their detection	• Introduction to adulteration • Types of adulterants (intentional and non intentional) • Health hazards related to adulterants • Simple techniques for detection of food adulteration
Unit 4: Food laws and regulation	Theory Time Hours
Objectives: • To know about food law and regulation in Nepal	Content 4 hours • Introduction to food law and food regulation • Present scenario of food law in Nepal • Necessity and challenges
Unit 5: Food Control system in Nepal	Theory Time Hours
Objectives: • To know about food control system in Nepal	Content 4 hours • Role of government bodies in food control system • Introduction of DFTQC and other interrelated agencies
Unit 6: Good laboratory Practices	Theory Time Hours
Objectives: • To know about good laboratory practices	Content 6 hours • Introduction to GLP • Principles of GLP • Handling of laboratory equipment • Use of safety measures in laboratory • Documentation and record keeping

Unit 7: Food additives	Theory Time Hours
Objectives: • To know the safety aspects of food additives	Content 6 hours • regulatory provisions of food additives (color and preservatives) • Safety aspect of food additives (colors and preservatives)
Unit 8: Food sampling techniques	Theory Time Hours
Objectives: • Learn about sampling techniques	Content 2 hours • Introduction to sampling • Types of sampling techniques • Sampling techniques for different food materials (solid and liquid)
Unit 9: Food plant sanitation and Hygiene	Theory Time Hours
Objectives: • To know about the techniques and tools of plant sanitation	Content 4 hours • Introduction to hygiene and sanitation • Personal hygiene and plant hygiene • CIP in plant sanitation • Cleaning reagents and sanitizers
Unit 10 : Food safety tools	Theory Time Hours
Objectives: • To know about different food safety tools (GMP, GHP, HACCP)	Content 8 hours • Basic concepts of GMP, GHP, GAP • Introduction to HACCP • Principles of HACCP • Steps in HACCP
Unit 11 : TQM and it philosophy	Theory Time Hours
Objectives: • To know about TQM and its philosophy	Content 6 hours • Introduction to TQM • Principles of TQM • Quality gurus and their philosophies
Unit 12: ISO series	Theory Time Hours
Objectives • To know about principles of ISO series(ISO-9001 ISO-22000, ISO 17025)	Content 4 hours • Introduction and principles of ISO • ISO series: 9001, 22000, 17025
Unit 13: Food standards	Theory Time Hours
Objectives: • To know about food standards	Content 4 hours • Concepts of food standards • Types of food standards (voluntary and mandatory)
Unit 14: Factory layout and design	Theory Time Hours
Objectives • To know relation of factory layout and design in safe food production	Content 2 hours • Importance of plant layout and design for safe food production

Unit 15: Concepts of SPS and TBT	Theory Time Hours
Objectives: • To know about SPS and TBT	Content 2 hours • General introduction to Sanitary and Phyto sanitary • General introduction to Technical Barrier to Trade (TBT)
Unit 16: CODEX and its functions	Theory Time Hours
• To understand the role of CODEX in standard formulation	Content 2 hours • Introduction to CODEX • Role of CODEX in standard formulation
Unit 17: Statistical Quality Control	Theory Time Hours
Objective: • To know the statistical quality control	Content 4 hours • Introduction to SQC • SQC in food processing • Tools of SQC

Teaching/learning activities and resources:

Classroom instruction, observation, illustration of diagrams and visual aids, text books

Evaluation Methods: Oral and written tests, assignments

Practical: Food Safety and Quality Control

Practical	**Hours practical: 39**
Practical 1: Sensory characteristic of food (food analysis)	Hrs: **4**
Objectives	**Content**
To assess quality attributes such as colour, flavor, texture, aroma, taste etc	Fruits and vegetable products, milk, meat and their products
Practical 2: Detection of adulterants	Hrs: **8**
Objectives	**Content**
Identification of various adulterants	Fats and oils, Milk, turmeric, cereals, Sweets and honey
Practical 3: Grading of cereals, legumes & oilseeds	Hrs: **4**
Objectives	Content
Determination of foreign matter contamination	Cereals, legumes and oilseeds
Practical 4: Field visit to Food Processing Industries	Hrs: **10** Group presentation
Objectives	**Content**
To study Quality Management Systems like HACCP/ ISO adopted in food industries	Visit of milk and meat processing industries/ fruits and vegetables processing/snacks food industry

Practical 5: Study of Sampling Techniques	Hrs:**3**
Objectives	Content
To study sampling tools, methods and procedures for analysis	Cereals, milk, fats and oils spices
Practical 6: Study of Food production layout	Hrs: **8**
Objectives	Content
Study of design layout	Factory layout according to Good Practices
Practical 7: Study of Food Label	Hrs: **2**
Objectives	Content
To study food label information	Label information
Practical 8: Study of hazards	Hrs: 4
Objectives	Content
Demonstrate hazards in food	Demonstration of hazards (physical, chemical and microbiological) in specific food production system.

Storage and Packaging

Credit Hour: 4+2=6 hours per week **Full Marks: 75**

Total hours: 117

Theory: 78

Practical: 39

Course Description

This course provides knowledge of proper storage of different foods and their products along with the proper storage of different food items. This course also deals with the different physical, biological and chemical factors of grains and its products which effect the storage losses and also gives the knowledge of prevention of losses during storage. In addition to this, it provides the fundamental knowledge of compatibility of packaging materials to food.

Course Objectives

1. To discuss the different type of food losses and their prevention
2. To study the different factor which contribute the storage losses of food
3. To deal the different storage methods
4. To give the knowledge about the principle of packaging
5. To give the knowledge of different type of packaging materials
6. To discuss the package of food products compatibility

Text and Reference Books

1. Saner D. B. (1992). Storage of cereal grains and their products 4th ed. AACC USA.
2. Sinha R. N. and Mair W. E (1973). Grain Storage Part of a System. AVI Publishing Company USA.
3. Sahay K. and Singh K.K. (2001). Unit Operations of Agricultural Processing. Vikas Publishing House India.
4. Robertson Gordon L. (2013) Food Packaging Principle and Practice. Crc press USA
5. Lee Dong San, Yam Kit L. and PiergiovanniLuliano (2008) Food Packaging Science and Technology. Crc press USA

Unit 1: Storage system of major grain	**Theory, 6 hrs**
Objective • To provide the background of post harvest operation	**Contents** • Definition of storage of food and processed food • Post-harvest handling of Rice, Wheat, and Maize.
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.

Unit 2: Food losses and deterioration	**Theory 6 hrs.**
Objective • Learn different types of storage and losses of foods.	**Contents** • Types of losses • Factors affecting the losses • Assessment of the losses
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 3: Grain sampling	**Theory 6 hrs.**
Objectives • Provide the basic knowledge of sampling • Familiarize with sampling devices	**Contents** • Introduction of Grain Sampling • Theory of grain sampling • Ellis cup, Pelican, Trier, and their uses • Analysis of grain samples
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams & video clips.
Unit 4: Inspection	**Theory 4 hrs.**
Objective • Provide the background for inspection of storehouse, mills& premises.	**Contents** • Introduction of Inspection • Inspection of store house • Hidden and surface infestation • Identification of hidden and surface infestation
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 5: Biology of store pests.	**Theory 12 hrs.**
Objectives • Provide the background of insect & Rodent losses of food storage	**Contents** • Study of morphology of Insect • Losses by Insect • Their control by physical methods and chemical methods. • Study the behaviour of rodent • Losses by rodent • Control methods: physical & chemical
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books,

	• Charts, diagrams, & video clips.
Unit 6: Micro-organism	**Theory 4 hrs.**
Objectives • Provide the basic knowledge of micro organism & storage loss	**Contents** • Introduction of Micro-organism • Storage loss by bacteria • Storage & field fungi • Their production of mycotoxins
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 7: Storage methods	**Theory 4 hrs.**
Objectives • Understand the basic knowledge of storage method	**Contents** • Bag storage methods • Bulk storage methods • Rural storage system and their improvement
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 8: Good storage practice	**Theory 2 hrs.**
Objectives • Impart the knowledge of good storage system	**Contents** • Techniques and factors of good warehouse practice and management
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.

B. Packaging

Unit 1: Scope & importance of packaging	**Theory 2 hrs**
Objective • Familiarize with importance of packaging	**Contents** • Definition of packaging • Importance of packaging • Scope of packaging • Function of packaging
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.

Unit 2: Hazards and packaging	**Theory 6 hrs**
Objective • Impart the knowledge of hazards of packaging	**Contents** • Mechanical damage • Physical hazards • Chemical hazards • Biological and microbiological hazards
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 3: Packaging materials	**Theory 10 hrs**
Objectives • Understand the idea about different packaging materials.	**Contents** • Properties of paper & paperboard • Types of paper & paperboard used in food packaging • Properties & types of plastic used in food packaging • Aluminum foil & laminates
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 4: Food packages	**Theory 8 hrs**
Objective • Familiarize the use of packaging materials	**Contents** • Bags, pouches and wraps • Folding cartons • Glass containers • Can • Traditional materials and packages
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 5: Special problems in food stuff packaging	**Theory 10 hrs**
Objective • Provide the knowledge of food package compatibility	**Contents** • Packaging of perishable and nonperishable food • Special problem in Dry food, Cooked food, Dairy products and Frozen meat

Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.
Unit 6: Quality control of packaging materials	**Theory 2 hrs**
Objective • Gain knowledge of quality control of packaging materials	**Contents** • Quality standards & control • Regulation & laws
Evaluation • Oral and written test, • Home assignments	**Teaching methods and materials** • Classrooms instructions, • Textbooks and references books, • Charts, diagrams, & video clips.

Practical

Course: Storage & packaging - 39 hrs

Practical 1: Post-harvest handling and marketing of grain	**2 hrs**
Objective • Study the handling & marketing system after harvest of grain	**Contents** • Flow-chart of harvesting of Rice, Maize, and Wheat. • Flow-chart of marketing system of grain
Practical 2: Determinations of physical properties of grain	**6 hrs.**
Objective • Evaluate dimensional and gravimetric properties of cereal grain	**Contents** • Determine the l, b and l/b ratio • Angle of repose • Bulk density • Porosity • 1000 kernels weight
Practical 3: Grading & Inspection	**6 hrs**
Objective • Learn grading & inspection of store grain	**Contents** • Government mandatory of grading of grain • Grading of paddy, milled raw and parboiled rice • Type & subtype of paddy & milled rice
Practical 4: Evaluation of packaging materials	**14 hrs**
Objective • Study the properties of paper, paperboard & plastic packaging	**Contents** • Determination of thickness of paper, paperboard & plastic packaging materials

materials	• Determination of moisture content of paper & paperboard • Determination of Cob test of paper & paperboard • Determination of ink adhesion of packaging materials
Practical 5: Test performance of packaging materials	**6 hrs**
Objective • Study of performance of food packaging materials	**Contents** • Determine the thermal sock of glass packaging materials • Determine the performance of can • Determine the performance of paper & plastic packaging materials
Practical 6: Visit to warehouse/rural storage structure	**5 hrs**
Objective • To know the modern & rural grain storage system	**Contents** • Field visit to different modern warehouse & rural storage system • Study fumigation system • Submit report of field visit

Technology of Food Products (Fruits and Vegetables)- II

Credit: 4+4 hour/week
Total hours: 156 **Full Marks: 100**
Theory: 78
Practical: 78

Course description

This course covers maturity, ripening process, harvesting method, sorting and grading, packaging, transportation, storage, nutritional value and types of processed products of fresh fruits and vegetables. This will provides basic principle, definition, process of manufacturing, storage, quality aspect, spoilage factors on processed products of fruits and vegetables. This course also provides basic knowledge on management and utilization of fruits and vegetables during glut season. Both the theory and practical knowledge of technology help the students to develop more confidence.

Course objective

1. To understand the principle of fruits and vegetables preservation.
2. To provide the knowledge on manufacturing process of different processed products like Squashes, RTS, fruit juices, jams, jellies, marmalades, Candied, preserves, ketchups, sauces, pickles, chutney etc.
3. To provide the knowledge on packaging, storage, quality product and causes of spoilage of the product
4. Upon completion of this course, students are able to work in fruits and vegetables industries and also able to conduct their own small scale industry.

Reference books

1. Preservation of fruits and vegetables---By Girdhari Lal, G. S. Siddappa and G.L. Tandon.Published by ICAR.
2. Principle of food Preservation ---By Ganga P Kherel, Fumio Hashinaga.
3. Postharvest Technology for small scale produce Marketers, Economic opportunities, Quality and Food safety By—Lisa Kitinoja and James R. Gorny, Department of Pomology, University of California, Davis.

Unit 1: Introduction of Fruits and Vegetables	**Theory Time 5 Hours:**
Objective -Understand fruits and vegetables, national production, productivity, nutritional importance, different processed product, spoilage of Fruits and vegetables.	Contents • production, productivity, uses • types of fruits and vegetables grown in temperate, tropical and subtropical zone. • nutritional importance and nutrient content in fruits and veg. • types of processed product of F/V • spoilage of fruits and vegetables. • postharvest losses.
Unit 2: Post harvest operation of fruits and vegetables	**Theory Time 14 Hours**
Objective -Understand maturity, ripening process of fruits, method of harvesting sorting, grading ,packaging transportation ,storage of Fruits and vegetables	Contents • Importance of maturity, stage of maturity of different F/V, maturity standard, ripening process of fruits, climacteric and non climacteric fruits, harvesting methods, collection centre, • importance and methods of sorting and grading ,packaging, transportation and storage of F/V • Principle of storage, Type of storage: cold storage, cellar storage, CA and MA storage.
Unit 3: Drying and Dehydration of fruits and vegetables	**Theory Time 9 Hours**
Objective: -Understand the principle of drying, method of drying, type of dryers for F/V drying, Dehydration and rehydration ratio.	Contents Principle of drying and dehydration, Importance of blanching for drying, method of Drying, Types of dryers used for drying of F/V, Sun drying, solar drying, cabinet dryer, method of fruit juice drying. Dehydration ratio, Rehydration ratio, storage of dried F/V, cause of spoilage of dried products.
Unit 4: Fruits and vegetables canning	**Theory Time 8 Hours**
Objective ; -Understand the principle of food processing method and familiar with canning and bottling of F/V.	Contents -principle of canning and bottling of F/V , types of can used for fruits and vegetables, detail process of canning of fruits and vegetables, causes and types of spoilage of canned food.
Unit 5: Fruit Beverages (squashes, RTS, juices, cordials and concentrate)	**Theory Time 11 Hours**
Objective Understand with the different types of equipment for fruit juice extraction, straining, filtration and clarification and preservation of fruit juices. -Familiar with preparation method of different products like squashes, cordials, juices, RTS from fruits.	Contents • Fruit juice extraction equipment like Juice extractor, basket press, straining, filtration and clarification and preservation of juices using chemical preservatives and pasteurization methods • Specification and preparation method of squashes, cordials, RTS (mango, litchi, apple)

	• Fruit juices, concentrate of juice, quality control, type of spoilage.
Unit 6: Pickles, Chutney and tomato products	**Theory Time 10 Hours**
Objective -Familiar with pickles, chutneys, sauces ,ketchup preparation method, keeping quality, causes of spoilage	Contents Pickling process, Preparation methods of pickles (oil pickle, mixed pickle), chutneys, keeping quality of pickle and chutneys and causes of spoilage. -specification and preparation method of tomato ketchup, sauces and keeping quality, causes of spoilage.
Unit 7: Jams, jellies and marmalades	**Theory Time 13 Hours**
Objective -Familiar with the term pectin and its sources, uses in food industries. -Understand the method of preparation of jam, jelly and marmalade from fruits, keeping quality, causes of spoilage.	Content -define pectin, pectin rich fruits, sources and uses of pectin, test of pectin in fruits using alcohol. -pulping of fruits, method of bulk storage of fruit pulp using chemical preservatives. -define jam, jelly and marmalade, types of fruits used for their preparation, jam preparation from apple, mixed fruit jam, mango jam. -Jelly and marmalade preparation from fruits. Defect of jam, jelly and marmalade, keeping quality and causes of spoilage.
Unit 8: Preserves, candied and Crystallized fruits	**Theory Time 5 Hours**
Objective -Understand the fruit products preserves, candied and crystallized fruits and its preparation methods	Contents -Define preserves, candied and crystallized fruits and selection of suitable fruits and vegetables. -Preparation method of preserves, candied and crystallized fruits from fruits and vegetables and proper packaging.
Unit 9: Plant layout and waste management	**Theory Time 3 Hours.**
Objective -Familiar with the plant layout of fruits and vegetables industries and necessary processing equipment, waste management	Contents - Meaning of plant layout. Importance, design and required processing equipment for the fruits and vegetables industries - Waste management of fruit and vegetable industries.
Evaluation methods: -Written exams. Internal assessment, class test, demonstration. This method evaluation is carried out in the entire unit.	Teaching methodology: Classroom instruction, Textbooks, reference, diagram Flowcharts.

Practical: Technology of Fruits and Vegetables **Hours Practical 78**

Practical: 1 Sorting, grading, and packaging of fresh fruits and vegetables. Hrs. 4

Objective	Contents
-Understand the selection of fruits and vegetable for marketing purpose. -Identify different grade of fruits and Vegetables and type of packaging for transportation.	-Visit collection centre of fruits and vegetables/ Carryout in Pilot plant.

Practical 2: Preparation of Syrup and brine solution Hrs. 4

Objective	Content
-Familiar with preparation method of syrup and brine and handling of refracto meter and salometer	-Preparation of different strength of syrup and brine from sugar and salt and test using Refracto meter and Salometer.

Practical 3: Blanching of fruits and vegetables and test of per-oxidase and catalase Hrs. 4

Objective	Content
-Familiar with the process of blanching and test of Peroxidase and catalase.	-Blanching of fruits and vegetables and test of peroxidase and catalase.

Practical 4: Preparation of fruit squashes (Orange/ lemon/ Pineapple) Hrs. 8

Objective	Content
Familiar with the process of preparation of squashes and calculation of required amount of ingredients as per specification	• Specification of squashes • And preparation of squashes from different fruits.

Practical 5: Preparation of mixed fruit jam and apple jam. Hrs. 8

Objective	Content
-Familiar with the process of jam preparation method and required amount of ingredients.	• Preparation of mixed fruit jam and apple jam using standard method. • test the pectin content of the fruit using of absolute alcohol.

Practical 6: Preparation of jelly and marmalade from fruits Hrs. 8

Objective	Content
-Familiar with the process of jelly and marmalade preparation method and required ingredients.	• Preparation of fruit jelly and fruit marmalade • Test the pectin content of the fruit using absolute alcohol

Practical 7: Preparation of Ready to serve (RTS) drink from fruits like mango, litchi and orange. Hrs. 8

Objective	Content
-Know the process of preparation method of RTS and required ingredients.	-Preparation of RTS from mango/ litchi/ orange using standard specification.

Practical 8: Dehydration of fruits and vegetables and calculate the dehydration and rehydration ratio. Hrs. 8

Objective	Content
-Understand the process of dehydration of fruits and vegetables, packing and storage.	-Dehydration of fruits and vegetables (Apple, green leafy vegetables, cabbage.) using solar and Cabinet Dryers, packing and storage of dried product -Calculate the dehydration and rehydration ratio of driedfruits and vegetables.

Practical 9: Preparation of preserves, candy from the fruits and vegetables. Hrs. 6

Objective	Content
-Familiar with the process of preparation method of preserves, and candy from fruits and vegetables.	-Preparation of preserves and candy from the fruits and vegetables.

Practical 10: Preparation of tomato products (Ketchup, sauces) Hrs. 8

Objective	Content
-Understand the process of preparation method of ketchup and sauses fro tomato and know the required ingredients.	-Preparation of tomato ketchup, sauses using standard specification.

Practical 11: Preparation of pickle and chutney from fruit and vegetables. Hrs.6

Objective	Content
Familiar with the process and preparation method of pickles and chutney from fruits and vegetables. -Familiar with the required ingredients pickle and chutney.	-Preparation of pickle and chutney from fruits and vegetables.

Practical 12: Visit fruits and vegetables industry. Hrs.6

Objective	Content
-Familiar with incoming raw materials, processing equipments, utensils, preparation of products, storage of processed products, packing and distribution.	-Visit fruits and vegetables Industries locally available

Technology Food Products (Tea, Coffee and Species) III

Credit: 4+2 hour/week
Total hours: 117 **Full Marks: 75**
Theory: 78
Practical: 39

Course Description

This course provides basic knowledge on importance feasibility, Cultivation, variety, marketing & industries of tea, coffee and spices in Nepal. It's including composition, different processing methods & quality parameters of tea, coffee & spices. Processing technology of tea, cherry coffee & parchment coffee size grading, packaging & storage of tea & coffee. Also includes Quality evaluation, including cup testing sensory evaluation, detection of adulterations of tea, coffee & spices. Also provide chemical composition, processing, drying storage extraction of essential oil & oleoresin of different spices of Nepal. This course also provides basic knowledge on management and utilization of tea, coffee and spices with better quality during glut season. Both the theory and practical knowledge of technology help the students to develop more confidence.

Course Objectives

This course will be delivered course objectives the students with broad objective to make them capable to knowledge & skill on basic processing, packaging storage, quality evaluation of tea coffee & major spices.

The specific objectives are as follows:-

- Provide the basic knowledge on cultivation, variety, production & industries of tea, coffee spices in Nepal.
- Provide the skill & technique for processing of tea, cherry & parchment coffee & different major spices produce in Nepal.
- Provide the skills technique for drying and dehydration of different major spices.
- Provide the skills for storage & packaging of tea, coffee & spices.
- Provide the knowledge of detection of adulteration & quality parameter.
- Develop the skill in extraction of oleoresin & essential oil of major spices of Nepal.
- To provide the knowledge of value added product development.
- Upon completion of this course, students are able to work in small industries of tea, coffee and spices and also capable to conduct their own small scale industry.

Text books:

7. Clarke, R.J.& Macrae, R (eds) Coffee vol-1 & 2 Chemistry & Technology. Elsevier Applied Science Publisher London & New York 1985.
8. Eden J(1976) Tea 3rd edition Long Man London.
9. Harter C.R. Tea Manufacture, Oxford University press, London. 1963.
10. Pruthi JS. Spices & condiments ICAR New Delhi 1998.
11. Oli P, 2011 Post-Harvest Technology on Tea, Coffee & Spices, publisher Lalitpur Valley College, Lalitpur.
12. Banerjee B, 1996, Tea Production& Processing , Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.

Course: Technology of Tea, Coffee & Spices	**Hrs. Theory: 78 , Hrs. Practical : 39**
Unit 1 : Introduction of Tea and Coffee (production, cultivation, variety)	Theory Time Hours
Objectives • Understand Tea & Coffee on national productivity, cultivation variety. • Indentify tea & coffee industries in Nepal.	Content 8 hours • Introduction of Tea and Coffee • Production, productivity • Variety of tea & coffee • Cultivation techniques • Coffee & tea industries in Nepal
Unit 2 : Processing of Tea.	Theory Time Hours
Objective	Content 12 hours
Explain plucking, withering rolling, fermentation, drying, grading and packaging of tea.	• Importance of Plucking technique and practice • Methods of transportation • Withering technique, physical and chemical changes during withering, degree of withering • Importance of rolling, different types of roller • Importance of fermentation, chemical changes during fermentation, aroma and colour strength development, different methods of fermentation, • Importance of drying, different types of dryer • Importance and method of sorting, grading and packaging, different types of packaging material and storage
Unit 3: Processing of Coffee	Theory Time Hours
Objectives	Contents 12 hours
Explain different processing methods (pulping technique, fermentation, drying, hulling, grading, packaging and storage of coffee beans.)	Picking and grading techniques, different processing method (dry and wet), pulping technique, fermentation methods, drying techniques, hulling method, grading method and it's important, packaging and storage of coffee beans.

Unit 4: Quality of tea and coffee.	Theory Time Hours
Objectives	Contents 14 hours
• Define the quality parameters and composition of tea and coffee. • Detect adulteration in tea and coffee.	• Definition of quality • composition of tea and coffee • different factor affecting parameters • Different types of adulteration. • detection technique of adulteration
Evaluation Methods: Oral and written tests, assignments	**Teaching/learning activities and resources:** classroom instruction, observation, illustration of diagrams and visual aids, text books
Unit 5: Production, Processing and quality evaluation of spices	Theory Time Hours
Objectives	Contents 8 hours
• Explain commercial production of ginger . • Describe production, chemical composition, processing, drying, storage and quality evaluation of ginger.	• Definition of spices. • Cultivation practice • National Production and productivity • chemical composition • different processing methods of ginger. • drying methods and technique of packaging • Economic benefit of packaging & storage.
Objectives	Contents 6 hours
• Explain commercial production of turmeric. • Describe production, chemical composition, processing, drying, storage and quality evaluation of turmeric.	• Cultivation practice • National Production and productivity • chemical composition • different processing methods of turmeric. • drying methods and technique of packaging • Economic benefit of packaging & storage.
Objectives	Contents 6 hours
• Explain commercial production of chillies . • Describe production, chemical composition, processing, drying, storage and quality evaluation of chillies.	• Cultivation practice • National Production and productivity • chemical composition • different processing methods of chillies. • drying methods and technique of packaging • Economic benefit of packaging & storage.
Objectives	Contents 8 hours
• Explain commercial production of cardamom . • Describe production, chemical composition, processing, drying, storage and quality evaluation of cardamom.	• Cultivation practice • National Production and productivity • chemical composition • different processing methods of big cardamom. • drying methods and technique of packaging • Economic benefit of packaging & storage.

Objectives	Contents 4 hours
• Define and explain commercial production of black pepper. • Describe production, chemical composition, processing, drying, storage and quality evaluation of pepper.	• Cultivation practice • National Production and productivity • chemical composition • Different processing methods of black paper. • drying methods and technique of packaging • Economic benefit of packaging & storage.
Evaluation Methods: Oral and written tests, assignments	**Teaching/learning activities and resources:** classroom instruction, observation, illustration of diagrams and visual aids, text books

Practical tea, coffee & spices

Tea, Coffee & Spices Practical	Hours practical: 39
Practical 1: Identification of different types of tea (CTC, Orthodox, Green)	Hrs:2
Objectives	Content
Identification different types of tea, Collect different variety of tea	Identification and collection of different variety of tea samples
Practical 2: Identification of different types of coffee beans	Hrs:2
Objectives	Content
Identification different types of coffee beans Collect different variety of Coffee beans	Identification and collection of different variety of Coffee beans (parchment and Cheery coffee) samples
Practical 3: Quality Parameter analysis of tea	Hrs:3
Objectives	Content
To analysis of moisture and Crude fiber content in tea	Determine the Moisture and crude fibre content in tea for to know the plucking methods.
Practical 4: Perform organoleptic test	Hrs:4
Objectives	Content
Perform the cup testing	Perform the tea testing with standard cup testing method.
Practical 5: Grade tea and coffee after drying and hulling respectively	Hrs:4
Objectives	Content
Perform the grading of different grade tea and coffee	Perform the tea testing with standard cup testing method and graded the tea and coffee in different grade.
Practical 6: Determination moisture and oil from different spices	Hrs:8
Objectives	Content
Determine moisture and extract essential oil, oleoresin and total oil from different spices	Perform moisture content Perform extraction of essential oil from different spices Perform extraction of oleoresin from different spices Perform extraction of total oil from different spices

Practical 7: Processing of Sutho	Hrs:4
Objectives	Content
Preparation of sutho and dehydration of ginger.	Preparation of sutho and drying and dehydration.
Practical 8: Processing of chillies and turmeric after harvesting	Hrs:12
Objectives	Content
Perform drying and dehydration of different spices	Perform drying and dehydration of harvested different spices (chillies and turmeric).

Technology of Food Products (Meat, Poultry and Fish)- IV

Credit: 3+3 hour/week
Total hours: 117 **Full Marks: 75**
Theory: 59
Practical: 58

Course Description

The course aims to provide basic knowledge and skills for quality production of meat and meat products. The major focus of this course shall be on developing competency in good slaughtering practices, production of quality meat and meat products, proper handling and preservation techniques, testing and quality analysis of meat, fish and poultry products.

Course Objectives

1. Define composition and nutritive value of meat tissues.
2. Handle pre-slaughter, slaughtering and dressing of meat animals.
3. Explain postmortem changes in meat (muscle).
4. Accomplice meat cutting and packaging.
5. Manufacture of meat products.
6. Grade and preserve eggs.
7. Preserve fish by some common methods of fish preservation.

Recommended Books:

- Subba, D., Text book of meat and poultry technology. (Current Edition). National College of Food Science and Technology. Delta Offset Press, Thapathali, Kathmandu
- Subba, D., Practical handbook of meat, fish and poultry.(Current Edition). National College of Food Science and Technology.Delta Offset Press, Thapathali, Kathmandu
- Sharma, B.D., Meat and meat products technology. (Current edition). Jaypeebrothers medical publishers (P) Ltd, New Delhi.

Course: Technology of Meat, Poultry and Fish	**Theory: 59 hrs. Practical: 58 hrs.**
Unit 1: Composition and nutritive values of meat	**Theory: 4 hrs.**
Objectives	**Contents**
Understand meat, composition of muscle tissue and the nutritive value of meat.	• Definition of meat, skeletal muscle, connective tissue, smooth muscle, cardiac muscle. • Composition of muscle tissue: water, protein, lipid, carbohydrate, minerals and vitamins • Nutritive values of meat (protein, fat, minerals and vitamins)
Evaluation: Oral and written tests, home assignments.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, diagrams, visuals
Unit 2: Pre-slaughter handling, Slaughtering and dressing of meat animals (poultry, pig, goat, etc.) and slaughterhouse management	**Theory: 12 hrs.**
2.1.Pre-slaughter handling, slaughtering and dressing of meat animals	**Theory: 6hrs.**
Objectives	**Contents**
• Understand the techniques of pre-slaughter handling of animals • Understanddifferent methods of slaughtering • Understandthe technique of slaughtering and dressing of meat animals e.g. Pork, goat and bufallo.	• Transportation techniques of meat animals, guidelines for preventing stress condition in meat animals • Ante-mortem inspection, different ritual methods of slaughtering • Definition of stunning and different methods of stunning • Bleeding techniques , dressing techniques, evisceration techniques, postmortem inspections, carcass chilling techniques
Evaluation: Oral and written tests, home assignment.	**Teaching Methods:** Classroom instruction, textbooks, reference books, diagrams, photographs, audio video of slaughtering.
2.2 Poultry slaughtering	**Theory:4 hrs**
Objectives	Contents
Understandthe technique of poultry slaughtering,	• Pre-slaughter handling and Ante-mortem

Ready To Cook (RTC) Chicken and cut up parts	inspection • Stunning, bleeding techniques , scalding, de-feathering, cropping and venting techniques, evisceration techniques, postmortem inspections, carcass chilling techniques. • Cut up parts
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, diagrams, photographs, audio video of slaughtering.
2.3 Slaughterhouse management	**Theory:2 hrs.**
Objectives	Contents
Understandslaughterhouse, its importance and hygiene practices in the slaughterhouse	• Definition of slaughterhouse, types, general equipment used hygiene practices.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, diagrams, photographs, audio video of slaughtering.
3 Postmortem changes in meat (muscle)	**Theory: 2 hrs.**
Objectives	Contents
Understandnormal and abnormal postmortem changes in meat	• Rigor mortis • PSE meat, DFD meat, Cold shortening, Thaw-rigor
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.
4 Meat cutting and packaging	**Theory: 4 hrs**
Objectives	Contents
Understandthe basic requirements in meat cutting, techniques of meat cutting (primal Cuts for pork and lamb/goat) and different techniques of meat packaging	Definition of meat cutting, basic requirements of proper meat cutting, primal cuts of pork and lamb/goat, importance of fresh meat packaging, different packaging techniques (Overwraps, tray with overwrap, shrink film overwrap, vacuum packaging, MAP).
Evaluation: Oral and written tests, home assignment **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books, charts, diagrams, photographs.

5 : Quality of meat	**Theory: 4 hrs.**
Objectives • Understandthe meat quality parameters and factors affecting meat quality	**Contents** • Sensory quality of meat • Technological quality of meat • Safety aspects of meat • Factors affecting quality of meat
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, audio video.
6: Meat preservation	**Theory: 8 hrs**
Objectives	Contents
Understandthe different methods of meat preservation	Use of different preservation techniques; low temperature, salting & curing, smoking, thermal processing, drying & dehydration, irradiation.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, audio video.
7:Technology of meat products	**Theory: 10 hrs.**
Objectives	**Contents**
Understandthe manufacturing process and technology of different kinds of meat products	Definition of the products, raw materials, manufacturing process • Sausage products, Cured meat, Smoked and Dried meat, Canned meat
Evaluation: Oral and written tests, home assignment	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, audio video.
8: Egg technology	**Theory: 6 hrs.**
Objectives • Understand the process of egg formation, composition and nutritive value • Understandthe egg grading system • Understandthe defects, spoilage of eggs and the methods of egg preservation	**Contents** • process of egg formation • composition and nutritive value • egg grading • egg spoilage and defects • methods of egg preservation

Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, audio video.
9. Fish preservation	**Theory: 6 hrs.**
Objective • Evaluate freshness of fish • Understand the different techniques and methods of fish preservation	Contents • Subjective evaluation of fish • Use of low temperature, salting (dry and wet curing), smoking, thermal processing, drying, pickling
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, audio video.
10. Meat by-products utilization	**Theory- 3 hrs.**
Objective • Understand meat byproducts, their classification and industrially important meat by-products	**Contents** • Definition, classification, importance of utilization, nutritional aspects of meat by-products • Uses of meat by-products: lard, tallow, gelatin, leather, blood, viscera
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, audio video.

Meat, Poultry and Fish		
Course: Practical		**Hrs. lab.58**
Objectives	**Contents**	
1. To learn slaughtering operations	Carry out slaughtering/ dressing and preparation of ready to cook chicken and cut up parts.	10
2. To learn how to determine the degree of water holding capacity of meat	• Determination of water holding capacity of meat • Determination of cooking loss and drip loss	8
3. To learn the preparation technique of different meat products	• Preparation of sausage/ cured meat/ ham/ bacon • Preparation of dry meat/ *sukuti*and *sekuwa*	14

4. To learn quality evaluation and grading of egg	Grading of egg by candling, USDA system and Haugh unit method.	8
5. To learn quality evaluation of fish	Grading of fish by subjective evaluation method.	5
6. To learn different fish preservation techniques	Preservation of fish by dry curing/ wet curing/ smoking/ drying/ pickling.	13
Evaluation methods: Practical performance, viva exams, practical record files.	**Teaching /Learning activities and resources:** Class room instruction, demonstration, Observation, illustration, diagrams, audiovideos, and reference books.	

Technology of Dairy Products

Credit hours: 4+4 hrs/week
Total hours: 156 **Full Marks: 100**
Theory: 78
Practical: 78

Course Description:

This course aims at providing Introduction and basic knowledge of Dairy Products to certificate level students of Food and Dairy Technology. After the completion of the course, the students will be able to implement their theoretical knowledge practically in daily life as well as in Dairy industries. As Students learn the way of manufacturing dairy products practically, it will broaden the knowledge about the subject matter more clearly. This course will definitely make student able to work in Small as well as large scale dairy industries and also helps to establish dairy related industries of their own.

Course Objectives:

After completing this course the students will be able to:

- Understand the definition of the Dairy products
- Understand the Composition of the Dairy products
- Understand the Manufacturing process/flow chart of the Dairy products
- Understand the storage and packaging materials used for Dairy products
- Practical implementation of the theoretical knowledge
- Work both in small as well as large scale dairy industries
- Establish or initiate dairy based industries or business of their own

Recommended Texts

1. Acharya Pushpa Prasad, Text Book of Dairy Technology, Highland Publication (P.)LTD
2. Acharya Pushpa Prasad, Text Book of Dairy Chemistry, Highland Publication (P.)LTD
3. Sukumar De, Outlines of Dairy Technology, Oxford University Press.

Reference Texts

1. Heinrich von Bamberger, Milk and Dairy Product Technology
2. **Varnam** A., **Sutherland** Jane P., Milk and Milk product

Courses:	**Hrs. Theory: Hrs. Practical :**
Unit 1: Cream	**4 Hrs. Theory**
Objectives	**Contents**
Understand the concept of manufacturing process of cream	• Definition/purpose • Composition of Cream • Manufacturing process • Classification • (Definition and Fat content of Table cream, Light cream, Coffee cream, Whipping cream, Heavy cream, Plastic cream) • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 2: Butter	**4 Hrs. Theory**
Objectives	**Contents**
Understand the concept of manufacturing process of butter	• Definition/purpose • Composition of butter • Manufacturing process (Cultured and Uncultured) • Classification • (Definition and Fat content of Table butter, white butter, cultured butter and uncultured butter) • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 3: Ghee	**4 Hrs theory**
Objectives	**Contents**
Understand the Traditional and Improved method of Ghee manufacturing	• Definition/purpose • Composition • Methods of Manufacture a. Traditional or Deshi Method b. Creamery Method c. Creamery Butter Method d. Pre-Stratification Method • Packaging and storage • Uses

Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, Flowcharts, textbooks, and reference books.
Unit 4: Milk powder	**8 Hrs Theory**
Objectives	**Contents**
Understanding on Milk powder manufacturing processes	• Definitions / purpose (Dried/Milk Powder, WMP, SMP) • Composition • Milk Drying Methods a. Film/Roller/Drum Drying b. Spray Drying • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 5 : Condensed/Evaporated Milk	**6 Hrs Theory**
Objectives	**Contents**
Develop the knowledge on Condensed and Evaporated Milk, Manufacturing Process and its Types.	• Definition/purpose (Condensed Milk, Evaporated Milk) • Composition • Manufacturing Process (Condensed and Evaporated Milk) • Packaging and Storage • Uses
Develop the knowledge on Condensed and Evaporated Milk, Manufacturing Process and its Types.	• Definition (Condensed Milk, Evaporated Milk) • Composition • Manufacturing Process (Condensed and Evaporated Milk) • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.

Unit 6: Cheese	**8 Hrs. Theory**
Objectives	**Contents**
Understanding the concept of manufacturing process of cheese	• Definition/purpose • Composition of Cheese • Manufacturing process • Classification • (Cheddar cheese, Roquforti cheese Kanchan cheese, Yak cheese) • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 7: Ice-cream	**4 Hrs. Theory**
Objectives	**Contents**
Understand the concept of manufacturing process of Ice-cream	• Definition/purpose • Composition of Ice-cream • Manufacturing process • Classification • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 8: Sterilized milk	**4 Hrs. Theory**
Objectives	**Contents**
Understand the concept of manufacturing process of sterilized milk	• Definition/purpose • Composition of sterilized milk • Manufacturing process • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.

Unit 9: Flavored milk	**4 Hrs. Theory**
Objectives	**Contents**
Understand the concept of manufacturing process of flavored milk	• Definition/purpose • Composition of flavored milk • Manufacturing process • Packaging and Storage • Uses
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 10 : Indigenous dairy Products	**20 Hrs Theory**
Objectives	**Contents**
Understandings on Indigenous Milk Products of Nepal	• Definition and Manufacturing Process • Composition and • Flowcharts of: *-Dahi/Lassi* *-Churpi,* *-Kurauni (Khoa),* *-Chhena* *-Sikarni*
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.
Unit 11: Milk Based Sweets	**12 Hrs Theory**
Objectives	**Contents**
Understanding the concept of various kinds of Milk based Sweets	• Definition/purpose • Composition • Manufacturing process, its scope in Nepalese Market • -*Kurauni (Khoa)* based sweets (Manufacturing of *Barfi, Peda, Lalmohan*) • -*Chhana* based Sweets (Manufacturing of *Rasbari, Chumchum*) • -Milk cake • Packaging and Storage
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, flowcharts, textbooks, and reference books.

Technology of milk products Practical		
Course: Practical		**78 Hrs**
S.N	**Contents**	
1	Analysis of Cream : Acidity, Fat, Moisture content	4hrs
2	Analysis of Butter : Acidity, Fat, Moisture content, Overrun	6hrs
3	Analysis of Ghee : Acidity, Fat, Moisture content	4hrs
4	Analysis of Condensed Milk: Acidity, Fat, Moisture content	4hrs
5	Analysis of Powdered milk: Acidity, Fat, Moisture content	4hrs
6	Manufacturing of *Khoa*	4hrs
7	Manufacturingof *Khoa* based Sweets: *Lalmohan*	4hrs
8	Manufacturing of *Chhena/ Paneer*	4hrs
9	Manufacturing of *Chhena* based Sweets: *Rasbari*	4hrs
10	Analysis of Ice-cream: Total solids, Fat, Overrun	6 hrs
11	Analysis of *Dahi*: Moisture, Acidity	4 hrs
12	Analysis of *khoa* : Moisture, Fat	6 hrs
13	Analysis of *Chhena:* Moisture, Fat	6 hrs
14	Analysis of cheese: Moisture, Fat, Acidity	6 hrs
15	Field Visit: Dairy product manufacturing industry	12 hrs

Sixth Semester

Food Analysis

Total hours: 156 **Full Marks: 100**
Theory: 39
Practical: 117

Course description
The course in Food Analysis is designed to provide student knowledge on the Principles of chemical and instrumental methods for the qualitative and quantitative analysis of major food components i.e. moisture, protein, carbohydrate, lipids, dietary fiber, minerals and vitamins. The course covers Practical exercises in the analysis of major food components utilizing chemical and instrumental methods.

Course objective
Upon completion of the course the students will be able to:
(i) Demonstrate a sound theoretical knowledge of the basic principles, importance and methods of food analysis.
(ii) Demonstrate a sound theoretical knowledge and practical skills of modern analytical methods applicable to the analysis of food.
(iii) Demonstrate practical knowledge of selected food analysis techniques.
(iv) Carryout microbiological and sensory analysis of food
(v) Carryout sampling and statistical treatment of data
(vi) Carryout total analysis of water

Recommended Texts
1. Handbook of Analysis of Fruits and Vegetables by S. Rangana
2. Basic food analysis handbook by K. C., Jagat Bahadur and Rai, Basanta Kumar

Course: Food Analysis	**Theory: 39 hrs** **Practical 117 hrs**
Unit 1: 1. Introduction, importance and methods of food analysis	**Theory: 4 hrs**
Objectives	Contents
1. Understand the importance of food analysis and its' techniques 2. Introduce Lab facilities, safety and report writing	• Introduction, Importance, different techniques of food analysis • Lab overview : guidelines, safety and report writing
Evaluation: Oral and written tests, home assignments.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, Visit to laboratory facilities
Unit 2: Sampling of food stuffs	**Theory: 4 hrs**
Objectives	**Contents**
1. Understand concept of sampling and different methods of sampling 2. Understand sampling procedure	Sample, Population, Sampling methods, types of samples (Solid, Liquid), Sampling procedure, Sample preparation, Sample handing and

3. Understand concept of error in food analysis	preservation, sampling errors
Evaluation: Oral and written tests, home assignment.	**Teaching Methods:** Classroom instruction, Class room demonstration, textbooks, reference books
Unit 3: Statistical treatment of data	**Theory: 4 hrs**
Objectives	Contents
1. Learn concept of statistics in food analysis 2. Learn Central tendency and dispersion of data 3. Learn various statistical tools used in food analysis	Mean, Standard deviation, Variance, Standard error, Degrees of freedom, Statistical hypothesis, Level of significance, One-tailed and two-tailed tests, Confidence limit, ANOVA and SPSS.
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs. Audio-visuals
Unit 4: Proximate and Ultimate analysis of food	**Theory: 8 hrs**
Objectives	Contents
1. Understanding of proximate constituents of food, difference between proximate analysis and ultimate analysis 2. Carry out analysis of different components of food	• Concept of proximate analysis and ultimate analysis • Analysis of proximate constituents of foods i.e. Moisture, Crude protein, Crude fat, Crude fiber, Ash, Carbohydrate, Acidity, Alcohol etc. • Quantitative Determination of Vit C, SO_2, Benzoic acid, Reducing sugar, Total Sugar, Acid-insoluble Ash
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, and audio-visuals
Unit 5 : Chromatographic techniques	**Theory: 3 hrs**
Objectives	Contents
Understanding principle of Chromatography and Uses of selected Chromatographic techniques	• Principles of Chromatography • Types of Chromatographic techniques • Paper Chromatography, TLC • Basic concept of HPLC • Chromatographic separation and identification of dyes and free amino acids in food samples
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials :** Classroom instruction, textbooks, reference books, photographs, audio visuals

Unit 6 Spectrophotometric techniques	**Theory: 4 hrs**
Objectives	Contents
Understanding principle of Spectrophotometry and it's uses	• Principles of Spectrophotometry • Determination of Nitrite content of food by Spectrophotometric method
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, audio vusuals
Unit 7: Sensory Evaluation	**Theory: 2 hrs**
Objectives	Content
Understand sensory evaluation of food	Sensory evaluation of food, Different methods of sensory evaluation, Hedonic Scale
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, Audio-Visual, photographs.
Unit 8: Microbiological Analysis of Food	**Theory: 4 hrs**
Objectives	**Content**
Understand working principles of microbiological analysis	Microbiological analysis of food, Analysis of Coliform, , Total Plate Count
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, photographs, Audio-Visual.
Unit 8: Analysis of Water	**Theory: 6 hrs**
Objectives	**Content**
Understand Standard, treatment and analysis of water	Standard of drinking water, Water Treatment, Analysis of physiochemical (pH, Total dissolved solids, Hardness, Alkalinity) and microbiological characteristics (Standard Plate Count, Coliform) of water
Evaluation: Oral and written tests, home assignment.	**Teaching Methods or Materials:** **Classroom instruction, textbooks, reference books, charts, diagrams, photographs.**

Practical

Practical	**117 Hrs**
Calibration of measuring devices (pipettes, burettes, and vol. flasks)	4 hrs
Preparation of standard solutions	4 hrs
Analysis of proximate constituents of foods i.e. Moisture (hot air oven and dean stark apparatus), Crude protein (Kjeldahl and Formal Titration method), Crude fat, Crude fiber, Ash, Carbohydrate (by difference), Acidity.	30 hrs
Determine alcohol content in alcoholic beverages	4 hrs
Carry out Quantitative Determination of Vit C, SO_2, Benzoic acid, Reducing sugar, Total Sugar, Acid-insoluble Ash, alcoholic acidity	26 hrs
Qualitative Analysis of food adulterants (milk, turmeric, honey, sweets)	10 hrs
Carry out Chromatographic separation and identification of dyes	7 hrs
Determine Nitrite content of food by Spectrophotometric method	6 hrs
Carryout Sensory analysis of food using Hedonic rating method	6 hrs
Carryout Physiochemical (pH, Total dissolved solids, Hardness, Alkalinity) and Microbiological analysis (Coliform, , Total Plate Count) of water	20 hrs

Project Work

Credit Hours: 2 + 6 = 8 Hours/Week **Full Marks: 100**
Total: 156 Hours
Theory: 39 Hours
Practical: 117 Hours

Course Description

The course covers fundamental aspects of research methodology applied in social research scientific research and developmental projects. The course deals with the techniques involved in preparing research proposal, writing research project report and publishing research findings in scientific journals. It also gives knowledge regarding food plant location and plant layout.

Course objectives

1. To understand the basic knowledge of research project and developmental project
2. To acquaint with the methodology used in project proposal preparation and report writing.
3. To understand importance and technique of plant location and layout.

Text and reference books

1. Agrawal, G.R. (2003). Project Management in Nepal. M. K. Publishers and Distributors, Kathmandu, Nepal.
2. Singh, M.L. (2005). Understanding Research Methodology. National Book Centre, Kathmandu, Nepal.
3. Adhikari, G.P. (2000). Proposal and Thesis Writing. Ratna Pustak Bhandar, Kathmandu, Nepal
4. Kothari, C.R. and Garg, G (2014). Research Methodology – Methods and Techniques, 3rd Edn. New Age International (P) Ltd., New Delhi, India.
5. Gupta, S.P. (2002). Statistical Methods, 31st Edn. Sultan Chand and Sons Educational Publishers, New Delhi, India.

THEORY

Course: Project Work	**Theory: 39 h Practical: 117 h**
Unit 1: Research methodology:	**Time: 5 h**
Objectives ○ To understand research and research process. ○ To apply adaptive research methodology	Contents ○ Meaning, objectives and types of research ○ Scientific research process ○ Criteria of a good research

	○ Definition and selection of research problem
Unit 2: Research design	**Time: 7 h**
Objectives ○ To gain knowledge about research design ○ To acquaint with different types of research design	Contents ○ Meaning of research design ○ Need of research design ○ Features of good research design ○ Important concepts related to research design ○ Types of experimental designs
Unit 3: Research hypothesis	**Time: 3 h**
Objectives ○ To understand research hypothesis ○ To enable in formulating hypothesis	Contents ○ Definition and characteristics of hypothesis ○ Sources, utility and types of hypothesis ○ Stating problems and hypothesis
Unit 4: Research report writing	**Time: 7 h**
○ To familiarize students with different types of research and project reports ○ To understand process of publishing research work	○ Introduction and importance of research reports ○ Components of reports ○ Publication of the research work.
Unit 5: Project work	**Time: 3 h**
Objective ○ To understand the meaning and types of project work	Contents ○ Introduction and purpose of project work ○ Steps and methods of project work
Unit 6: Food plant location and layout	**Time: 3 h**
Objectives To understand the principle involved in food plant location and layout	Contents ○ Introduction to plant location and layout ○ Objectives and factors affecting plant location ○ Types of plant layout
Unit 7: Developmental project	**Time: 11 h**
Objectives ○ To understand about developmental projects ○ To familiarize with project management process ○ To understand about project monitoring and evaluation processes	Contents ○ Concept, characteristics and life cycle of developmental project ○ Concepts, characteristics and benefits of project management ○ Meaning, principles, and process of project planning ○ Concept, types and cycle of project

	control ○ Meaning of project monitoring and evaluation ○ Logical framework matrix
PRACTICAL: 117 Hours	
Course: Project writing	
Practical 1: Select/evaluate project	**Time: 20 h**
Objective To enable students in preparing research proposal	Contents ○ Review of literature ○ Research topic selection ○ Setting research hypotheses ○ Proposal writing
Practical 2: Statistical analysis of experimental data	**Time: 23 h**
Objective To give ideas about the different statistical methods used in data analysis	Contents ○ Review of statistical techniques in data analysis (t- test, Chi-square test, F-test, regression) ○ Presentation of data (Table, figure, diagram etc.)
Practical 3: To carry out project work	**Time: 31 h**
Objective To acquaint the students in conducting, writing and presenting project work	Contents ○ Review of literature ○ Project work formulation and initiation ○ Report preparation and presentation.
Practical 4: Research report writing and presentation	**Time: 30 h**
Objective To familiarize students with scientific and developmental project report writing and presentation	Content ○ To prepare research report ○ To present report
Practical 5: Scientific paper writing	**Time: 13 h**
Objective To learn about the method of publishing research work in scientific journal	○ To collect data from different experiments conducted in Food Analysis subject ○ To analyze and present the data ○ To write paper and present it in the class

Work Experience Program (WEP)

Credit Hours: 0+24
Full Marks: Practical 300

Course Description

The Work Experience Program (WEP) is a 3 months (12 weeks/ 72 working days) program that aims to provide students an opportunity for meaningful career related experiences by working fulltime in real organizational settings where they can practice and expand upon their classroom based knowledge and skills before graduating. It will also help students gain a clearer sense of what they still need to learn and provides an opportunity to build professional networks.

General objectives:

The objective of the WEP is to make students familiar with/ gain firsthand experience of the world of work as well as to provide them an opportunity to gain skills that are new or not covered in the institute.

Course Objectives

The objective of the WEP is to help students to:

1. Apply knowledge and skills learned in the classroom in actual work settings or conditions and develop practical experience before graduating.
2. Acquire deeper knowledge of the industry in which the work is done.
3. Gain an opportunity to work effectively with professional colleagues and experience their activities and functions.
4. Develop specific, vocational and personal skills as well as learn those disciplines, skills and attitudes which can be best learnt on the job.
5. Gain an opportunity to strengthen portfolio or resume with practical experience and projects.
6. Gain a learning experience that could even lead to entry level job opportunities within the company.
7. Develop a greater understanding about career options while more clearly defining personal career goals.
8. Obtain an opportunity to increase level of maturity and grasp of work culture.
9. Establish professional contacts and network.
10. Identify areas for future knowledge and skill development.

REQUIREMENTS FOR SUCCESSFUL COMPLETION OF THE WEP:

- Satisfactory completion of 12 weeks (3 months) of the WEP in an approved organization as attested by the concerned official of the organization.
- Preparation and submission of WEP report within 2 weeks of completion.
- Approval of the submitted WEP report by the College's Supervisor.
- At least 60% % marks secured out of 100.

Activity:

In this program the students will be placed in the job market under the supervision of supervisors in the organizations such as food industries (biscuits, bread, meat, fats and oil, rice, wheat, legumes and maize mills, beverage, fruits and vegetables, noodles, snacks, confectionaries, brewery and distilleries, tea, coffee, spices, winery, water processing, sugar refineries) and dairy industries as well as regulatory government and non government agencies, and academic institutions. The nature of work is practical and the duration will be of three 12 weeks (480 hours). The student will be eligible for WEP only after the completion of all classes of the subjects included in the curriculum. WEP should be completed at least 2 weeks before the start of 3rd year final examination of CTEVT. The institute will make arrangement for WEP. The institute will inform the CTEVT at least one month prior to the WEP placement date along with plan, schedule, the name of the students and their corresponding WEP site.

A) Complete WEP Plan

SN	Activities	Duration	Remarks
1	Orientation	2 days	Before WEP placement
2	Report to the site	1 days	Before WEP placement
3	Actual work at the WEP site	90 days/480 hours	During WEP period
4	Mid-term evaluation	one week (for all sites)	After 6 to 7 week of WEP start date
5	Report to the parental organization	1 days	After WEP placement
6	Final report preparation	5 days	After WEP completion
7	Seminar/ evaluation from CTEVT or its nominee(external)	3 days	After 10 days of completion of WEP

- After 6 weeks of WEP placement mid-term evaluation should be made by the institute or jointly with CTEVT.
- After completion of 3 months WEP period, students will be provided with one week period to review all the works and prepare a comprehensive final report.
- WEP seminar date and time will be fixed by the institute after one week of the completion of WEP by making consent with the CTEVT.
- Final evaluation will be made according to the marks at the following evaluation scheme but mid-term evaluation record will also be considered.

B) Evaluation scheme:

Evaluation and mark distribution is as follows:

S. N.	Who does evaluate?	Marks
1	Supervisor of the organization in which the student is placed for WEP	100
2	The Training Institute	100
3	CTEVT or its nominee (external)*	100
	Total	**300**

*** Students are required to secure 50 percent marks in the external examination conducted by CTEVT to pass the course.**