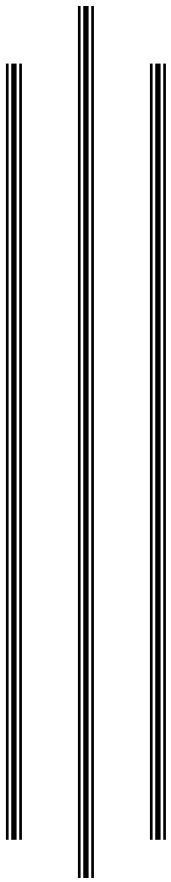
CURRICULUM

FOR

DIPLOMA IN AGRICULTURE

(Intermediate of Science in Agriculture)

Major: Plant Science



Council for Technical Education and Vocational Training (CTEVT)

Curriculum Development Division

Sanothimi, Bhaktapur

Revised, May, 2014

Contents

Mission of the Curriculum

The mission of the curriculum is to educate and train, and produce good quality middle level agriculture personnel equipped with sound skills and knowledge of plant science along with extension and community development.

Strategy

The strategy is to achieve our mission of educational excellence by maintaining expert faculty, implementing a sound curriculum and recruiting and producing quality students.

Philosophy

The philosophy of the curriculum is based on the development of both effective and efficient agriculture and extension service providers as professionals for fulfilling the present needs of people with its socio-cultural impacts on community farm management. The approach will focus on addressing second-generation issues of present agriculture sector such as community development, commercial agriculture soil conservation etc.

Programme Description

This course is based on the job required to be performed by a middle level agriculture technician in different institutions of Nepal. **Diploma in Agriculture** course extends over 3 years. The first year focuses on basic sciences and fundamental subjects, the second year on agriculture, soil management and conservation, community development and running a farmer field school, and the third year is given to cover the other agriculture related subjects and to the application of learned theory and skill development within comprehensive practice settings in both agriculture related institutions and communities.

Aim and Objectives of the program

Main aim of this three-year job-oriented academic Programme in agriculture after the SLC graduation is envisaged by the institute. The 3 years Diploma Programme is therefore oriented to include fundamental courses in the first year. Remaining two years are concentrated for agriculture sciences including the

course on entrepreneurship, which is limited in past I. Sc. courses. It is generally felt that there is greater need to have middle level human resources capable of taking establishing the self enterprise. This course is designed to fulfill this gap. Besides, this vocational course will address a long-felt need for a shorter course aimed at imparting practical agriculture skills and also opening up a host of employment and entrepreneurial possibilities to students. The overall objective of the program is to produce qualified agriculture technical human resources required for livelihood improvement of community through the participatory methods.

Aim

The aim of this course is to produce mid-level human resources equipped with knowledge and skills in agriculture and allied subjects

Objectives

The objectives of this course are summarized as follows.

- to provide *technical knowledge and skills* in different aspects of agriculture, horticulture and plant protection with community development and entreprenurship.
- to produce quality human resources to provide technical and managerial services in public and private agriculture sector
- to develop *competency in* agriculture related enterprises
- to provide extensive field based experiences to meet specific and growing needs of different agriculture and horticulture stakeholders

Conceptual Framework

The major focus of this Programme is to produce qualified agriculture technicians for supporting good governance and to improve equitable livelihood of farmers especially addressing the needs of disadvantaged groups and women of the community. The course structure deals with theory and practical aspects of agriculture improvement of community group members, individuals and it is designed on modular basis.

The course will have two components: **Core course and content course**. Basic science, mathematics and language course is termed as core course and all agriculture courses are termed as content course. The module for first year is designed with basic science courses: Physics**,** Chemistry**,** Botany, Zoology and Mathematics, Nepali, English.

The subjects for second year includes Agriculture related specialization subjects: **Name of courses:** Crop production, Horticulture, Plant Protection, seed Technology.

The module for the third year includes: **Name of courses:** Entrepreneurship Development and Field Practice which will be of months in different fields.

Both agriculture and livestock students will study same course in first year and 3 subject same in second year also. i.e Extension and community development, agribusiness management and Aquaculture and fishery. In third year On-the-Job training is compulsery with respective field.

Finally, the course should reflects:

- the need of present Agriculture service in proper management
- the respect gained from the communities through professional services.

- the roles and responsibilities of Agriculture TECHNICIAN personnel to improve the Agriculture production and management as an enterprise to improve the livelihood of farmers.
- the development of professionalism in Agriculture sector by addressing the present needs

Target Groups

SLC passed with second division youths are the target groups for this course.

Group Size

There will be 40 students in a batch.

Entry Criteria

The entry criteria are:

- School Leaving Certificate (SLC) with second division.
- Entrance examination will be organized to test the entry qualification of students, which will be administered by the CTEVT.
- Final selection will be made on the basis of merit list. Student quota for different categories should be fixed as per CTEVT policies.
- Candidates will submit the following documents at the time of application:
    - SLC passed certificate
    - Character certificate
    - Citizenship certificate (only for the verification of students name, parent's name, age, date of birth and address)

Medium of Instruction

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

Course Duration

The duration of the course will be of **three years**. The first year course is termed as core course and the second and third year courses as applied course. One academic year consists of maximum of 39 academic weeks. In this 39 weeks student will attend at internal theory, practical classes and final exam. Rest of 13 week they will go for summer/ winter and other festival vacction and one academic week consists of maximum of 40 hours.

Pattern of attendance

The students should secure at least 90 percent of attendance during the course in the classroom and 95 percent attendance at the fieldwork to appear in annual and final examinations.

Teacher and student ratio

The subject specialists of English, Nepali, Physics, Chemistry, Mathematics, Botany, Zoology as well as agriculture related and community development related with enterprises development course will be the lecturer. Their qualification will have Bachelor degree in related subjects. They will

possess the academic and technical knowledge of agriculture, community development and business/enterprise development services, Chemistry, Physics, English and Nepali with some experience. Additional qualifications will be the experience of community planning and implementation through participatory rural appraisal or participatory rapid appraisal, and also the expertise in facilitation, group mobilization and presentation, case analysis and reporting, data analysis, planning process, livelihood improvement plan preparation and implementation process, marketing and development; financial management etc.

The overall ratio between teachers and students will be as follows:

- Overall ratio of teacher and students must be 1:20 at the institutional level.
- Teacher and student ratio for practical demonstration 1:10.
- Minimum of 75% of the teachers must be fulltime.

Program Coordinator, Teacher and Demonstrator

The qualification of the Program Coordinator, Teacher and Demonstrator will be as follows:

- The program coordinator must be a master degree holder in related field or he/she will have Bachelor degree in related field with minimum of 5 years experience in teaching activities or service after completion of the Bachelor degree.
- The teacher must be a bachelor's degree holder in related field
- The demonstrator must have an intermediate level degree in related field with minimum of 2 years experience in teaching activities.
- The basic science and general subject teachers must have a master's degree in the related discipline.

Instructional Media and Materials

The following instructional media and materials will be used:

- ***Printed media materials:*** Assignment sheets, case studies, handouts, performance checklists, textbooks etc.
- ***Non-project media materials:*** Displays, models, photographs, flipchart, poster, writing board etc.
- ***Projected media materials****:* Slides, overhead transparencies, opaque projections etc.
- ***Audio-visual materials:*** Audiotapes, films, slide-tapes, videodisc, videotapes etc.
- ***Computer based instructional materials:*** Computer based training, interactive video etc.

Teaching learning methodologies

This will be a combination of several approaches such as illustrated lecture, group discussion, demonstration, simulation, role play, guided practice, practical work, field visits, laboratory observation and work, report writing, term paper presentation, case analysis, tutoring etc. The main teaching and learning methodology will be as follows:

- Theory: Lecture, Group discussion, assignment and group work etc.
- Practical: Demonstration, observation and self-practice.

Disciplinary and Ethical Requirements

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

Evaluation Scheme

a. *Internal assessment*

- ❖ There shall be a transparent evaluation system for each subject both in theory and practical exposure.
- ❖ Each subject will have internal evaluation at regular intervals of 4 months including formal and informal evaluation approaches and students must get the feedback about it.
- ❖ (Weight age of theory and practical marks will be 20% and 40% respectively.)
- ❖ The theoretical and practical assessment format must be used as per CTEVT developed and applied by the evaluators for evaluating student's performance in each subject related to the theoretical and practical experiences.

b. *Final examination*

- ❖ Weight age of theory and practical marks will be 80% and 60% respectively
- ❖ Students must pass in all subjects both in theory and practical to qualify for certification. If a student becomes unable to succeed in any subject s/he shall appear in the re-examination as administered by CTEVT.
- ❖ Students shall be allowed to appear in final examination only after completing the internal assessment requirements.

c. *Requirements for final practical examination*

- ❖ Qualified Agriculture /relevant subject teacher must evaluate final practical examinations.
- ❖ One evaluator in one setting can evaluate not more than 20 students in a day.
- ❖ 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 an external evaluator nominated by CTEVT.
- ❖ Provision of re-examination shall be as per CTEVT policy.

Pass Marks

The pass marks for theory and practical examinations are:

- ❖ 40% in theory examination
- ❖ 60% in practical examination

Grading System

The following grading system will be adopted:

- Distinction: 80% and above
- First division: 65% to below 80%
- Pass division: 40% in theory and 60% in practical

Certification

The council for technical education and vocational training will award certificates in **"Diploma in Agriculture"** to the candidates who successfully complete the requirements as prescribed by the CTEVT.

Career Path

The graduates would be eligible to work as mid-level technicians (Junior Technician, JT) in Agriculture sector as prescribed by the Public Service Commission or the concerned authorities. The graduates would also be eligible to apply for the entrance examination administered by the Institute of Agriculture.

Course Structure

First Year

SN	Subject	Credit hours/week	Contact Hours/week	Full Marks
1	English	5+0	5	100
2	Nepali	5+0	5	100
3	Physics	4+1	6	100
4	Mathematics	6+0	6	100
5	Chemistry	4+1	6	100
6	Botany	4+1	6	100
7	Zoology	4+1	6	100
	Total	32 + 4	40	700

Second Year

SN	Subject	Credit hour/week	Contact hour/week	Full marks
1	Extension and Community Development	3+1	5	100
2	Agribusiness Management and Cooperative	3+1	5	100
3	Aquaculture and Fisheries	2+1	4	100
4	Introductory Animal Husbandry	2+1	4	100
5	Principles and Practices of Agronomy	3+1	5	100
6	Plant Protection	3+1	5	100
7	Soil Management, Conservation and Environmental Science	3+1	5	100
8	Post Harvest Technology	1+1	3	50
9	Statistics and Computer Application	2+1	4	100
	Total	22+9	40	850

Third Year

SN	Subject	Credit Hours/week	Contact hours/week	Full marks
1	Commercial Vegetable Production	2+1	4	100
2	Medicinal and Non Timber Forest Product	2+1	4	100
3	Crop Production	3+1	5	100
4	Plant Breeding and Seed Production Technology	3+1	5	100
5	Industrial Entomology and Mushroom Cultivation	3+1	5	100
6	Ornamental Horticulture and Nursery Management	2+1	4	100
7	Fruits and Plantation Crops	3+1	5	100
8	Work Experience Program (WEP)	0+4	8/day	300
	Total	18+11	40	1000
	Grand Total for Plant Science	95		2500

Note: Work Experience Program (WEP): 3 months (3 months *4 weeks*40 hours = 480 hours)

2. The contact hours of third year subjects must be 40 hours/week. 3. WEP should be completed before third year final examination.

4. The WEP plan is attach hearwith.

Detail of creadit hours and marks for Diploma in Agriculture

First year

SN	Subject	Mode		Weekly hours	Distribution of Marks						Total Marks
					Theory			Practical			
		T	P		Internal	Final	Time	Internal	Final	Time	
1	English	5	0	5	20	80	3	-	-	-	100
2	Nepali	5	0	5	20	80	3	-	-	-	100
3	Physics	4	2	6	16	64	3	8	12	3	100
4	Mathematics	6	0	6	20	80	3	-	-	-	100
5	Chemistry	4	2	6	16	64	3	8	12	3	100
6	Botany	4	2	6	16	64	3	8	12	3	100
7	Zoology	4	2	6	16	64	3	8	12	3	100
	Total	**32**	**8**	**40**	**124**	**496**		**32**	**48**		**700**

Second Year

SN	Subject	Mode		Weekly hours	Distribution of Marks						Total Marks
					Theory			Practical			
		T	P		Internal	Final	Time	Internal	Final	Time	
1	Extension and Community Development	3	2	5	16	64	3	8	12	3	100
2	Agribusiness Management and Cooperative	3	2	5	16	64	3	8	12	3	100
3	Aquaculture and Fisheries	2	2	4	16	64	3	8	12	3	100
4	Statistics and Computer Application	2	2	4	16	64	3	8	12	3	100
5	Introductory Animal Husbandry	2	2	4	16	64	3	8	12	3	100
6	Principles and Practices of Agronomy	3	2	5	16	64	3	8	12	3	100
7	Plant Protection	3	2	5	16	64	3	8	12	3	100
8	Soil Management, Conservation and Environmental Science	3	2	5	16	64	3	8	12	3	100
9	Post Harvest Technology	1	2	3	8	32	1.5	4	6	3	50
	Total	**22**	**18**	**40**	**136**	**544**		**68**	**102**		**850**

Third Year

SN	Subject	Mode		Weekly hours	Distribution of Marks						Total Marks
					Theory			Practical			
		T	P		Internal	Final	Time	Internal	Final	Time	
1.	Commercial Vegetable Production	2	2	4	16	64	3	8	12	3	100
2.	Medicinal and Non Timber Forest Product	2	2	5	16	64	3	8	12	3	100
3.	Crop Production	3	2	5	16	64	3	8	12	3	100
4.	Plant Breeding and Seed Production Technology	3	2	5	16	64	3	8	12	3	100
5.	Industrial Entomology and Mushroom Cultivation	3	2	5	16	64	3	8	12	3	100
6.	Ornamental Horticulture and Nursery Management	2	2	4	16	64	3	8	12	3	100
7.	Fruits and Plantation Crops	3	2	5	16	64	3	8	12	3	100
8.	Work Experience Program (WEP)	As per WEP rules									300
	Total	***18***	***14***	***32***							***1000***

First Year

1. English
2. Nepali
3. Physics
4. Mathematics
5. Chemistry
6. Botany
7. Zoology

English

Credit Hour: 5 **Full Marks**: 100

Total hours: 160

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 1**
Core English	**Time hours 15×6 = 90**
Unit 1: Experiences and achievements	**Theory Time hrs 6**
Objectives	Contents
Make sentences using past simple and present perfect continuous Express new experience using active and passive gerund	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
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 6**
Objectives	Contents

Judge someone from appearance using sense verbs Describe peoples' physical appearance	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
Unit 3. Relating past events	**Theory Time hours 6**
Objectives	Contents
Describe earlier events using past perfect tenses Use non defining relative clause	Had stopped/had been stopped Had been trying/had done Who/whom/which/where/when
Unit 4. Attitudes and Reactions	**Theory Time hrs 6**
Objectives	Contents
Express attitude using verb and adjectives Express attitude strongly Express person's character	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
Unit 5. Duration	**Theory Time hrs 6**
Objectives	Contents

Make questions using duration structures How long?, for/until, in/by Make sentences using take and spend in activities and achievements 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 6**
Objectives	Contents
Change tenses involved in reported speech Report the sentences using special reporting verbs	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
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 6**
Objectives	Contents

Make deductions 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 6**
Objectives	Contents
Describe the things using effect verbs Listing advantages and disadvantages Advise on a course of action in terms of its advantages and disadvantages	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 being unemployed is that…. There is no point in+v4 You ought to/ ought not to/might as well+v1
Unit 9: Clarifying	**Theory Time hrs 6**
Objectives	Contents

Ask questions to get information Make indirect questions Form tag questions	What kind of/ sort of/….? What colour/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 6**
Make a wish or express dissatisfaction Make sentences using second conditional structures Express regret.	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
Unit 11: Events in sequence	**Theory Time hrs 6**
Objectives	Contents

Narrate the events in sequence Write the events in right(expected) and wrong order(unexpected) Talk about an unexpected event following immediately on another.	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 doneX 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…
Unit 12: Comparison	**Theory Time hours 6**
Objectives	Contents
Compare the things to show the differences Compare numerically using dimension nouns and adjectives Make comparison with different tenses	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 time 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>
Unit 13: Processes	**Theory Time hrs 6**
Objectives	Contents
Connect two types of sequence Emphasize the right order Give instruction	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

Vocabulary: Natural process: melt, dissolve, evaporate freeze, condense, congeal	
Unit 14: Prediction	**Theory Time hrs 6**
Objectives	Contents
Express probability in prediction Make sentences using conditional predictions- 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 6**
Objectives	Contents
Make news of recent events Make questions for finding out news Indicate that the information is based on hearsay 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. (15+24+24+4 = 67)
Objectives	
Have general understanding of 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. (5×3 = 15)

	• The grandmother, Ray your Bear • The Lamentation of the old Pensioner, W.B. Yeats. • Full fathom five thy father lies, Shakespeare • Travelling Through The Dark, William Stafford. • God's Grandeur, Gerard Manley Hopkins
Story	Theory hrs. (6×4 = 24)
	• About love, Anton Chekhov • A story, Dylan Thoma • The Last Voyage of the Ghost Ship • The Tell-tale Heart, Edgar Allan Poe • Hansel & Gretel, Jacob & Wilhelm Grimm • The Boarding House, James Joyce.
Essays	Theory hrs (6×4 = 24)
	• 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. • Women's Business, Ilene Kantrov • The Children Who Wait, Marsha Traugot. • A Child is Born, Germaine Greer.
Drama	Theory hrs (1×4 = 4)
	• Purgatory, W.B. Yeats.
Internal Assessment	Time hours 2

Evaluation Scheme:

This paper carries 100 marks, which will be divided as follows.

Core English – 60 %

Extensive Reading and Writing – 40%

Skill wise weight age will be on follows:

Reading	-35 %
Writing	-35 %
Grammar and language use	-30 %

Time Planning:

Course introduction	1
Core English	15×6 = 90
Extensive Reading	67
Internal assessment	2
Total hrs	160

Prescribed Texts:

1. Doff, Adrian, Christopher Jones, Keth Mitchell, Meanings into Words (Upper Intermediate) Student's Book and Work Book, Cambridge: Cambridge University Press, 1984.
2. The Heritage of Words: Ekta Books, Kathmandu, 1996.

अनिवार्य नेपाली

पाठ्यभार : ५ घण्टा प्रति हप्ता **कुल पूर्णा□ः १००**

कुल समय : १६० घण्टा

परिचय र उद्धेश्यः यो पाठ्यांश कृषि र पशुविज्ञान डिप्लोमा (प्रवीणता) तहमा अध्ययन गर्ने विद्यार्थीहरुमा नेपाली भाषासम्बन्धी आधारभुत क्षमताको विकासको लागि राखिएको हो । यो पाठ्यांश पूरा गरेपछि विद्यार्थीहरु निम्नलिखित कुरामा सक्षम हुनेछन् :

१. स्तरअनुरुप संबद्ध विषयक्षेत्रमा प्रयोग हुने कथ्य र लेख्य नेपाली भाषासम्बन्धी बोध र अभिव्यक्ति क्षमता बढाउन ।

२. सम्बद्ध विषयक्षेत्रका पुस्तक, पत्रिका, लेख आदि सामग्री पढी स्तरीय भाषामा बुद्दा टिपोट, संक्षेपीकरण, विवेचना र समीक्षा गर्ने क्षमता वृद्धि गर्न ।

३. संबद्ध व्यावहारिक सन्दर्भका अनुच्छेद, चिठी, सूचना, विज्ञापन, निबन्ध, टिप्पणी आदि प्रयोगमा देखिएका भाषिक त्रुटिहरुप्रति सचेत भई तिनको निराकरणतर्फ उन्मुख हुन् ।

४. वर्णविन्यास र वाक्यतत्वसम्बन्धी स्तरीय भाषामा भाव अभिव्यक्त गर्ने क्षमता प्राप्तगर्न ।

खण्ड क : व्याकरण अंक ५० **पाठ्यभार ६०**

एकाइ १. वर्ण र अक्षरको संरचनाको पहिचान अंक : ५, पाठ्यभार ५

वर्ण र वर्णविन्यास :

(क) उच्चार्य वर्णहरुको परिचय :

- नेपाली स्वर र व्यन्जन बर्णहरुको परिचय र वर्गीकरण (उच्चारणस्थान, प्रयत्न, घोषत्व र प्राणत्वका आधारमा)
- देवनागरी लिपि र कथ्य नेपाली वर्णहरु

ख) नेपाली उच्चरित अक्षरहरुको संरचना

स्वर र व्यञ्जनको शब्दगत अक्षर संरचना र अक्षर सख्या ।

एकाई २: वर्णविन्यास र चिन्ह परिचयः अंक ५, पाठ्यभार ६

क) कथ्य र लेख्य नेपाली भाषामा भिन्नता

ह्रस्व-दीर्घ (इ, उ), स□श□ष, ब□व, व□ओ, य□ए, ऋ□रि, क्ष□छे, क्ष्य□छ्य, शिरविन्दू र चन्द्रविन्दू, हलन्त, पदयोग र पदवियोग तथा लेख्य(चिन्ह सम्बन्धी अशूद्धि(सशोधन अभ्यास

ख) तत्सम, तद्भव र आगन्तुक शव्दका सन्दर्भमा नेपाली वर्णविन्यासको ज्ञान र अभ्यास ।

अ) ह्रस्व र दीर्घ (इ ई, उ ऊ) सम्बन्धी नियम र अपवादहरु

आ) श, ष, स,

इ) ब् , व्

ई) व्□ओ, य□ए, ऋ□रि, क्ष□छे, क्ष्य□छ्य,

उ) □, ञ्,ण्, न्,म्, तथा शिरविन्दु र चन्द्विन्दु

ऊ) हलन्तसम्बन्धी नियम र अपवादहरु

ए) पदयोग र पदबियोगसम्बन्धी नियमहरु

ऐ) तत्सम शब्दका सन्दर्भमा उपसर्ग र प्रत्ययसम्बन्धी वर्णविन्यास ।

ग) लेख्य चिन्हहरुको प्रयोग: पूर्णविराम, अल्पविराम, अर्धविराम, प्रश्नबोधक विस्मयादिबोधक, निर्देशक, कोष्ठ र उद्धरणसम्बन्धी चिन्हको ज्ञान र अभ्यास ।

एकाई ३: शब्दवर्ग र शब्दरुपायन: अं□:१० पाठ्यभार: १२

क) स्रोत: तत्सम, तद्भव र आगन्तुक, व्युत्पादन: पूर्वसर्ग (उपसर्ग), परसर्ग (प्रत्यय), समास र □ित्व (विभिन्न शब्दवर्ग वा पदको स्रोत बनोट र कार्यका आधारमा शब्दहरुको ज्ञान, पहिचान र अभ्यास ।)

ख) नाम, सर्वनाम, विशेषण, क्रियापद, क्रियायोगी, नामयोगी, संयोजक, विस्मयादिबोधक र निपातजस्ता शब्दवर्ग वा पदकोटिहरुको सोदाहरण परिचय, पहिचान र अभ्यास ।

ग) रुपायन: नाम, सर्वनाम र विशेषणको लि□, वचन र आदरका आधारमा रुपायन र रुपावलीको सोदाहरण, परिचय र अभ्यास ।

घ) लि□, वचन, पुरुष, आदर, काल, पक्ष, भाव, वाच्य र अकरणका आधारमा क्रियापदका रुपायनको सोदाहरण परिचय र अभ्यास ।

एकाई ४ : शब्दनिर्माण (सन्धिसहित) अं□ : १० पाठ्यभार : १२

क) शब्द र शब्दव्युत्पादनको प्रक्रिया, मूल शब्द र व्यूत्पन्न शब्द (पूर्वसर्ग, परसर्ग, समास र □त्व प्रक्रिया): व्युत्पादन र रुपायनको भिन्नताको ज्ञान र अभ्यास ।

ख) सर्गपद्धति□रा शब्दनिर्माण (

पूर्वसर्ग (उपसर्ग) □रा शब्दनिर्माण:

अ, अन, कु, बे, बि, बद्

प्र, परा, अप, सम्, अनु, अब, वि, अधि, अति, उत्, प्रति, परि, उप, सु, निर्, दुस्, दुर् ।

परसर्ग (प्रत्यय) □रा शब्दनिर्माण (

निम्नलिखत कृत् प्रत्ययको ज्ञान र अभ्यास :

नु, ने, एको, तो, दो, एर, ई, न, आइ, ओट, आवट, अत, ओ, आउ, आहा, अक्कड, अन्त, उवा, इलो ।

अक, अन, इत, त, ता, ति, य, तव्य, अनीय ।

निम्नलिखित तद्धित प्रत्ययको ज्ञान र अभ्यास:

लो, आली, आलु, आहा, इया, इयार, इलो, औली, यौली, ए, एली, ले, आई, आइ□ याइ□ पन□पना ।

आलु, इक, इत, ई, ईय, ईन, ईण, क, तम, ता, त्व, मय, मान्, वान्, य ।

ग) समास□रा शब्दनिर्माण

समासको चिनारी, समास र विग्रहको प्रक्रिया एवं समस्तशब्दहरुको पहिचानको अभ्यास : समासका प्रमुख भेदहरु (तत्पुरुष, कर्मधारय, □ग, अव्ययीभाव, बहुब्रीहि र □ □ समासमात्र) र तिनका आधारमा समस्त शब्दहरुको निर्माण र विग्रह गर्ने एवं समासका नामको पहिचान गर्ने अभ्यास ।

घ) □त्व□रा शब्दनिर्माण : □त्व र अन्य व्युत्पादन प्रक्रियामा फरक, पूर्ण र आंशिक □त्व प्रक्रिया□रा शब्दनिर्माण गर्ने अभ्यास ।

□) सन्धि नियम :नेपानी तत्सम र तद्भव शब्दमा प्रयोग हुने प्रमुख सन्धि नियमको परिचय र अभ्यास ।

एकाई ५ : वाक्यतत्व : अंक १०, पाठ्यभार : १३

क) सरल वाक्यका उद्देश्य र विधेय तथा तिनको विस्तारको परिचयात्मक ज्ञान र अभ्यास ।

ख) क्रियाको परिचय :

अ) अकर्मक, सकर्मक, □कर्मक र पूराकापेक्षी तथा मुख्य र सहायक क्रियाको पहिचान ।

आ) प्रेरणार्थक क्रिया

इ) नामधातु

ई) सरल र संयुक्त क्रियामा फरक ।

ग) काल

अ) कालको परिचय

आ) भूत र अभूतकाल (वर्तमान र भविष्यत्)

घ) पक्ष:

अ) पक्षको परिचय

आ) काल र पक्षमा फरक

इ) पक्षका प्रकार सामान्य, पूर्ण, अपूर्ण, अभ्यस्त, अज्ञात, संभावना ।

□) भाव□अर्थ

अ) भाव वा अर्थको परिचय

आ) सामान्यार्थ, विध्यर्थ (आज्ञार्थ, इच्छार्थ), अनिश्चयार्थ (सम्भावनार्थ, सं□तार्थ) ।

च) बाच्य

अ) वाच्यको परिचय, वाक्यका भेद

आ) कर्तृवाच्य, कर्मवाच्य र भाववाच्यमा फरक

छ) संगति

अ) लि□, वचन, पुरुष, आदर आदिका आधारमा कर्ता र समापिका क्रियाबीच संगति

आ) विशेषण विशेष्य तथा भेदक भेद्यका बीचको सं□ति

इ) नाम र सर्वनामका बीचको स□ति

ज) कारक र विभक्ति

अ) कारकको परिचय, कारक र विभक्तिको सम्बन्ध, कारकका भेद

आ) कर्ता, कर्म, करण, सम्प्रदान, अपादान र अधिकरणका साथै सम्बन्ध र पूरकको परिचय

इ) प्रत्यक्ष र अप्रत्यक्ष कर्ममा फरक

ई) सरल र तिर्यक् कारक तथा तत्सम्बन्धी बिभक्ति नियम

उ) ले, लाई, मा, को, बाट, देखि विभक्तिको प्रयोगसम्बन्धी नियम ।

झ) पदक्रम :

अ) पदक्रमको चिनारी

आ) विशेषण विशेष्यको पदक्रम (भेदक, विशेषण र नाम, क्रियायोगी र क्रियाका वीच)

इ) कर्ता र क्रिया: कर्ता, कर्म, (अप्रत्यक्ष र प्रत्यक्ष कर्म) र क्रिया, कर्ता कर्म र क्रियायोगिकको पदक्रम ।

ई) व्याकरणात्मक र साहित्यिक (आलंकारिक) पदक्रम

एकाइ ६ : वाक्यका प्रकार र वाक्यान्तरण : अं□: १० पाठ्यभार: १२

वाक्यका प्रकार:

क) सरल, संयुक्त र मिश्र वाक्यको पहिचान र अभ्यास

ख) सरल सामान्य वाक्यको उद्देश्य र विधेय, तथा तिनको विस्तार चिन्ने अभ्यास ।

वाक्यान्तरण : सरल सामान्य वाक्यबाट विभिन्न अर्थकाका वाक्यमा परिर्वतन ।

ग) मिश्रवाक्यका मूख्य र आश्रित उपवाक्य चिन्ने अभ्यास ।

घ) सरल वाक्यबाट सरल, संयुक्त र मिश्र वाक्यमा वाक्यसंश्लेषण गर्ने अभ्यास ।

□) वाक्यसंश्लेषण गर्दा हुने संयोजक, सर्वनाम र असमापिका क्रियाको प्रयोग र विभिन्न पद र पदावलीको लोपको ज्ञान र अभ्यास ।

च) सरल वाक्यको नामीकरण, विशेषणीकरण र क्रियायोगीकरण ।

छ) प्रत्यक्ष कथन र अप्रत्यक्ष कथनका आधारमा उक्ति परिवर्तनको अभ्यास ।

खण्ड ख : प्रयोजनपरक, बोध, अभिव्यक्ति र कृतिसमीक्षा: अंक ५०, पाठ्यभार: ६०

एकाइ १: प्रयोजनपरक नेपाली : अंक: ५ पाठ्यभार: ५

क) भाषिक भेदको पहिचान

lnlvt / df}lvs e]bsf] klxrfg

cf}krfl/s / cgf}krfl/s e]bsf] klxrfg

ख) सामान्य र प्रयोजनपरक (प्रकार्यपरक) भेदको पहिचान

ग) कृषि, पशुपालन र पशुचिकित्सा एवं पशुस्वास्थ्य क्षेत्रमा प्रयुक्त नेपाली भाषाका विशेषताहरुको पहिचान । (बिषय, प्राविधिक शब्दावली, शब्दस्रोत, वाक्यगठन, शब्दनिर्माण, क्रिया, अभिव्यक्ति शैलीका सन्दर्भमा)

एकाई २: बोध र शब्दभण्डार तथा बुद्दा टिपोट र संक्षेपीकरण अंक: १३ पाठ्यभार: ५

क) ज्ञान विज्ञान (वातावरण, जनसंख्या आदि) प्रविधि र विशेषगरी कृषि पशुपालन तथा पशुचिकित्सा एवं पशुस्वास्थ्य क्षेत्रका (दृष्टांश तथा अदृष्टांश) सामग्रीको बोध गर्नाका साथै त्यस्तै सामग्रीमा आधारित बोधात्मक र भाषिक प्रश्नहरुको मर्म बुझी छोटो छरितो उत्तर दिने अभ्यास ।

ख) शब्दभण्डार:

उपर्युक्त किसिमका सामग्रीमा रहेका शब्दभण्डारमध्ये विशेष महत्वपूर्ण वा कठिन शब्दहरुको निर्माण, शब्दनिर्माणसहित अर्थ र वाक्य प्रयोगसम्बन्धी अभ्यास ।

ग) बुदा टिपोट:

उपर्युक्त सामग्रीका मुख्य मुख्य बुद्दा ठम्याई तिनलाई बुद्दाका रुपमा टिप्ने अभ्यास:

घ) संक्षेपीकरण:

बिस्तृत र संक्षिप्त अभिव्यक्तिमा पाइने भिन्नता पहिचान र कुनै अभिव्यक्तिमा रहेका विषयवस्तुका मूलभूत कुरा ठम्याई छोटकरी ढं□ले मितव्ययितापूर्ण भाषाशैलीमा मूल अभिव्यक्तिको एकतृतियांशमा संक्षेपीकरण गर्ने अभ्यास: यस क्रममा बिशेष गरी कृषि र पशुचिकित्सा क्षेत्रका गद्यका दृष्टांश र अदृष्टांश सामग्रीबाट अभ्यास गर्ने ।

एकाइ २: अनुच्छेदलेखन र पत्ररचना :अंक ४, पाठ्यभार ५

क) अनुच्छेदलेखन:

विभिन्न शैलीमा लेखिएका अनुच्छेदहरुको पहिचान र विशेषगरी कृषि पशुपालन तथा पशुचिकित्सा एवं पशुस्वास्थ्य विषयमा केन्द्रित भई गद्य अनुच्छेदलेखन गर्ने अभ्यास ।

ख) पत्ररचना :

पत्रलेखनका विभिन्न ढाचा एवं तरिकाको ज्ञान र अभ्यास: कार्यालयीय पत्र, निवेदन, सूचना, निमन्त्रणापत्र र विज्ञापनको रचनासम्बन्धी ज्ञान र लेखनको अभ्यास ।

एकाइ ३ : निबन्ध, टिप्पणी र प्रतिवेदन लेखन: अंक ८, पाठ्यभार १०

क) निबन्ध लेखन :

निबन्ध लेखनको सामान्य ढाचा र तरिकाको ज्ञान एवं अभ्यास: विभिन्न समसामयिक विषय र शीर्षकमा केन्द्रित रही तत्सम्बन्धी विषयबस्तुलाई क्रमबद्ध र व्यवस्थित ढंगले विस्तृत रुपमा गद्यात्मक अभिव्यक्ति गर्दै वस्तुपरक, आत्मपरक, भावपरक र विचारपरक निबन्ध लेख्ने अभ्यास ।

ख) टिप्पणीलेखन :

कुनै समसामयीक वा विशेष महत्वपूर्ण समस्या वा विषयलाई लिएर केही अनुच्छेदको प्रयोग गरी मझौला (नछोटो नलामो) आकारको गद्यात्मक अभिव्यक्ति दिई टिप्पणी लेख्ने तरिकाको ज्ञान एवं अभ्यास ।

ग) प्रतिवेदन लेखन :

आफूले देखेसुनेको, भोगेको, अनुभव गरेको र अध्ययन गरेको कुनै सन्दर्भ (घटना, सभा, समारोह, चाडपर्व, यात्रा, समस्या वा अन्य) विषयका कुरा तत्सम्बन्धी आफ्ना अनुभव, बिचार आदिको समावेश गरी लेखिने गद्यात्मक लामो अभिव्यक्तिस्वरुप प्रतिवेदन (वर्णन, विवरण वा रिपोर्ताज) लेख्ने तरीकाको ज्ञान र अभ्यास ।

एकाइ ४: कृतिसमीक्षा: अंक २० पाठ्यभार २५

निम्नलिखित कृतिबारे समीक्षा लेख्ने अभ्यास :

कविता:

लेखनाथ पौड्याल	नैतिक दृष्टान्त
लक्ष्मीप्रसाद देवकोटा	वन
गोपालप्रसाद रिमाल	परिवर्तन
सिद्धिचरण श्रेष्ठ	माग्नेको गीत
माधवप्रसाद घिमिरे	यही हो मेरो मिथिला
भूपि शेरचन	मेरो देश

एकाङ्कीनाटक:

बालकृष्ण सम	रणदुल्लभ (एकाङ्की)
विजय मल्ल	बहुला काजीको सपना (नाटक)

कथा:

गुरुप्रसाद मैनाली	छिमेकी
विश्वेश्वरप्रसाद कोइराला	सिपाही
भवानी भिक्षु	हारजित
इन्द्रबहादुर राई	रातभरि हुरी चल्यो
रमेश विकल	मधुमालतीको कथा

निबन्ध:

लक्ष्मीप्रसाद देवकोटा	वीरहरु
श्यामप्रसाद शर्मा	आइमाई साथी
भैरव अर्याल	महापुरुषको संगत

उपन्यास:

लीलबहादुर क्षेत्री	बसाइ□

कृतिसमीक्षाका आधारहरु विधा र कृतिहरु निम्नलिखित अनुसार हुन्छन् : शीर्षक, विषयवस्तु, मूलभाव र विचार, कथानक, पात्र, परिवेश, छन्द, लय, दृश्यविधान, संवाद आदि ।

शिक्षणसम्बन्धी निर्देशन :

यो तहअर्न्तगत प्रथम बर्षको सय पूर्णा□को एक पत्रका रुपमा रहेको यो अनिवार्य नेपाली पत्रको शिक्षण गर्दा शिक्षकहरुले निम्नलिखित कुराहरुमा विशेष ध्यान दिई विद्यार्थीहरुलाई सम्बन्धित शैक्षिक तहअनुरुप नेपाली भाषासम्बन्धी भाषिक सीपहरु प्राप्त गर्न सक्षम बनाउने ।

१. त्रुटिका क्षेत्र पहिल्याई निराकरणात्मक उपाय अ□ाल्ने, यस काममा वर्णविन्यास र वाक्यगठनमा विशेष ध्यान दिने ।

२. विद्यार्थीहरुमा पठनशीलता बढाउनका निम्ति तोकिएको पाठ्यपुस्तकका अतिरिक्त रोचक र ज्ञानप्रद सामग्री, लेख(रचना, पुस्तक आदिको सूचि बनाई उत्प्रेरित गर्न

३. व्याकरणका विभिन्न पाठ्यवस्तुको शिक्षणका क्रममा संज्ञान पक्ष र त्यसको प्रयोगात्मक अभ्यासका बीचमा समन्वय स्थापित गर्ने र आगमनात्मक पद्धतिको समेत प्रयोग गर्ने । श्रव्य(दृश्य सामग्रीमा आधारित प्रदर्शनात्मक विधि र व्याख्यानात्मक विधिसंग कक्षा छलफल र प्रश्नोत्तर विधिलाई पनि उपयुक्त अनुपातमा प्रयोग गर्ने ।

४. प्रयोजनपरक नेपालीको शिक्षण गर्दा संज्ञानात्मक पक्षलाई कम मात्रामा प्रयोग गरी कृषि र पशुचिकित्सा एवं पशुस्वास्थ्य क्षेत्रका विषयमा नेपाली भाषाको प्रयोगका नमूना संकलनगरी कक्षाकार्यका रुपमा त्यसका विशिष्टताको पहिचानमा जोड दिने ।

५. बोध र अभिव्यक्तिसम्बन्धी पाठ्यवस्तुको शिक्षण गर्दा संज्ञानात्मक पक्षलाई न्यूनतम रुपमा प्रयोग गरी अभ्यास पक्षमा जोड दिने, विभिन्न अभिव्यक्तिको अभ्यासका क्रममा शुद्ध र स्तरीय मौलिक अभिव्यक्ति पक्षमा पनि ध्यान दिने ।

६. कृति समीक्षासम्बन्धी पाठ्यवस्तुको शिक्षणगर्दा लेखकसम्बन्धी नदिई नहुने अति संक्षिप्त चिनारीमात्र दिई मुख्य रुपमा कृतिपरक अध्ययन र निर्धारित विभिन्न कोणमा आधारित विवेचना गर्ने वस्तुगत कृतिसमीक्षा पद्धतिमा नै जोड दिई अभ्यास समेत गराउने ।

७. समय समयमा सम्बन्धित पाठ्यवस्तुको शिक्षणलाई प्रभावकारी पार्न मद्धत पु□ाउने गरी गोष्ठीविधि पुस्तकालयीय अध्ययनविधिको पनि प्रयोग गर्ने, साथै साहित्यिक र बौद्धिक अतिरिक्त क्रियाकलापका माध्यमलाई पनि प्रयोग गर्ने, यसै क्रममा पाठ्यविषयसंग सम्बन्धित तुल्याई विशिष्ट वि□न, लेखक आदिको व्याख्यान, प्रवचन आदिको आयोजनालाई पनि सहायक शैक्षिक विधिका रुपमा प्रयोग गर्ने ।

८. समय समयमा सम्बन्धित पाठ्य विषयमा आधारित प्रश्न दिई गृहकार्य गराई सुधारात्मक टिप्पणी गरिदिने । वर्णविन्यास, शब्दनिर्माण, शब्दवर्ग (पदकोटि) आदिका पठनपाठनका क्रममा नेपाली शब्दकोशको प्रयोग गर्ने बानी बसाल्ने ।

एकाइ ५ : मूल्या□न योजना :

अवधारणा :

यस तहको मूल्या□न हाल प्रचलित मूल्या□न पद्धतिअनुसार लिखित परीक्षाका माध्यमबाट गरिनेछ । शैक्षिक सस्थाहरुले आफ्ना हिसाबले शैक्षिक स्तर उठाउन आन्तरिक परीक्षालाई पनि मूल्या□नको माध्यम बनाउनेछन् ।

प्रश्नहरु ज्ञानपरक मात्र नभई सीप र प्रयोगपरक पनि हुनेछन् । यस्तो मूल्या□कन□रा विद्यार्थीहरुको भाषिक प्रयोग व्याकरण, बोध र अभिव्यक्तिसम्बन्धी स्तरीयता एवं अभ्यासात्मक र सीपपरक क्षमतामा जोड दिइने छ ।

प्रयोग :

यसको मूल्या□न प्रक्रियाको उपयोग तल प्रस्तुत गरेको प्रश्न योजनाअनुसार लामो उत्तरात्मक र संक्षिप्त उत्तरात्मक प्रश्नहरु सोधी औपचारिक परीक्षाका माध्यमबाट गरिनेछ ।

पुस्तक तथा सहायक पुस्तकहरु

१. लिलबहादुर क्षेत्री — **बसाईं**, साझा प्रकाशन ।

२. मोहनराज शर्मा — **शब्दरचना र बर्णविन्यास, वाक्यतत्व र अभिव्यक्ति** (नयां संस्करण, काठमाण्डौ बुक सेन्टर, काठमाण्डौ ।

३. कृष्णप्रसाद पराजुली — **नेपाली अध्ययन तथा अभिव्यक्ति,** रत्नपुतक भण्डार काठमाण्डौ ।

४. हेमनाथ पौडेल — **अनिवार्य नेपाली व्याकरण बोध र अभिव्यक्ति**, पैरवी प्रकाशन, काठमाण्डौ ।

५. मुरलीधर घिमिरे — **अनिवार्य नेपाली,** हजुरको पुस्तक संसार, काठमाण्डौ

गोरखापत्र (सत्रावधिका, सम्पादकीय, टिप्पणी लेखहरु), गोरखापत्र सस्थान काठमाण्डौ

Physics

Total hours: 190 **Full Marks: 100**

Theory 128

Practical: 64

Course description

This course in physics is designed to provide students with an understanding of the scientific laws of our physical world and how the physical world and physics contribute to life's activities in modern society. 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 60% accuracy in practical.

Recommended text:

Brij Lai and Subramanyan, Principles of physics, *A text book of physics by Satya Prakash Part I & II*

Nelkon and parker, advanced level physics (5^{th} ed.)

Shrestha, U. P, Physics Practical Guide

Shrestha, V.K. Numerical examples in physics Vol. I and II Ratna Pustak Bhandar, Nepal.

Reference Texts:

- Pradhan J.M. and gupta, S.K, A textbook of physics (part i and ii)
- Verma, H.C, Concepts of physics i &ii
- Sears, Zemansky & young, University physics
- Haliday, D &Resnickm R. Physics Part i &ii

Course: Physics	**Hrs. Theory 128 Hrs. lab 64**
Unit 1: Mechanics	**Hrs. theory 30**
1.1 units and measurement	**Hrs. theory 3**
Objectives	**Content**
Measure precisely mass, length, time, volume, density, pressure and specific gravity. Define fundamental and derived units Explain MKS, CGS and SI system of units Convert one system of units into another system of units Express derived units in terms of fundamental units. 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 Demonstration of vernier callipers, Micro Meter screw gauge, speedometer, physical balance, spring balance and measuring cylinder.. 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.
1.2 scalar and vectors	**Hrs: theory 2**
Objectives	**Content**

Differentiate between vectors and scalars. Identify whether a physical quantity is scalar of vector. Resolve vectors into rectangular components. point out the resultant to two or more vectors by graphical method. 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
1.3 Kinematics	**Hrs: theory 4**
Objectives	**Content**
Define displacement, velocity, instantaneous velocity, average velocity, uniform velocity and acceleration retardation Differentiate between distance and displacement, speed and velocity. Write down the relation of kinematics equation of motion (linear and gravitational). Calculate the time of flight, maximum height and horizontal tangs of projectile. Solve simple problems related to the projectile.	Displacement, velocity, instantaneous velocity, 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
1.4 Force	**Hrs. theory 8**
Objectives	**Content**

State Newton's laws of motion. Give the concept of inertia of rest, motion and direction. Define force in terms of rate of change of momentum and give their directions Derive F= ma and use it to solve simple problems. State and prove principle of conservation of linear momentum with examples. Define angular displacement, angular velocity and angular acceleration. Distinguish between angular velocity and linear velocity and obtain the relation between them. Define circular motion, centripetal force and centrifugal force. Differentiate between elastic and inelastic collision. Define friction, laws of limiting friction and coefficient of friction	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. The magnitude of centripetal force and centrifugal force, $F=mv^2/r=mr\omega^2$ Friction, limiting friction, angle of friction and coefficient of friction. Law of limiting friction. The relation between angle of fraction and coefficient of fraction. 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
1.5 Work energy and power	**Hrs theory 3**
Objectives	**Content**
Fined work energy and power and give their units in various systems. Define KE and PE also give their magnitude. Relation between Watt and Horse power 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
1.6 Gravity and Gravitation	**Hrs theory 3**
Objectives	**Content**
State Newton's law of gravitation. Deduce unit and dimension of G. Define acceleration due to gravity and variation of g with height and depth Differentiate between mass and weight State the condition of equilibrium of a body Differentiate between center of gravity and center of mass. Define weightlessness Define escape velocity	Laws of gravitation F=GMm/ R2 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. Constitutions of equilibrium of a body with examples. Formula of escape velocity (No derivation) 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
1.7 Hydrostatics	**Hrs theory 3**
Objectives	**Content**
Explain that liquid pressure is proportional to the depth of the liquid and independent of the shape of the vessel. Define density, and specific gravity of solids and liquids. Explain rotary pump and lift pump	Fluid pressure and determination of the formula P=ρgh. Pascal's law. Density and specific gravity. Difference between density and specific gravity. Working principle of pumps

Explain Pascal's law and Archimedes's principle. State the principle of flotation and condition of equilibrium of floating bodies.	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.
1.8 Properties of matters	**Hrs theory 4**
Objectives	**Content**
Define elasticity State Hook's law of elasticity. Define stress, strain and Young's modulus of elasticity. Define viscosity. State Newton's formula of viscosity. Define coefficient of viscosity. Deduce unit and dimension of viscosity. Define terminal velocity. Define and explain surface tension. Explain Adhesive force and cohesive force. Explain phenomenon of capillarity (no derivation of formula). Solve related numerical problems.	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. 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.
Unit 2: Heat	**Hrs theory 20**
2.1 Thermometry	**Hrs theory 2**

Objectives	**Content**
Define heat and temperature and distinguish between them. Describe the sensitivity of a liquid thermometer. Determine the lower and upper fixed points of the thermometer. Define different temperature scales (Celsius, Fahrenheit and Kelvin) Convert one temperature scale into another using the temperature conversion formula. Solve numerical problems.	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
2.2 Thermal Expansion	**Hrs theory 3**
Objectives	**Content**
Describe linear, superficial and cubical expansion of solids and their expansivity. State the relation between linear, superficial and cubical expansivity of solids (not derivation). Define teal and apparent expansion of liquid. Explain the change in density of a substance with the variation of temperature. Discuss the density variation of water with temperature (anomalous properties of water).	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 $\beta=2 \alpha$. Apparent and real expansion of a liquid Change in density of an object due to change in 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

2.3 Heat capacity	**Hrs theory 3**
Objectives	**Contents**
Define heat capacity, specific heat capacity. Distinguish between joule and calories as heat unit. Explain the quantity of heat content of a body $Q=ms\theta$. Explain the energy required to cause a phase change at constant temperature. Define freezing, melting and boiling point of a substance. Explain latent heat of fusion and latent heat of vaporization. Discuss the effect of pressure on melting and boiling point of the substance.	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
2.4: Hygrometry	**Hrs theory 3**
Objectives	**Contents**
Explain saturated and unsaturated vapor. Define triple point. Define dew point, absolute humidity and relativity humidity. Explain dryness and dampness.	Definition of saturated and unsaturated vapors. Definition of triple point. Definition of dew point, absolute humidity and relativity humidity. Explanation of dryness and dampness.

Determine relative humidity by wet and dry bulb hygrometer. Explain Air conditioning. Solve related numerical problems.	Determination of relative humidity by wet and dry bulb hygrometer. Description of Air conditioning. 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
2.5: Transfer of heat	**Hrs theory 3**
Objectives	**Contents**
Differentiate between conduction, convection and radiation. Define thermal conductivity with its units. and dimension. Distinguish between good and bad conductors of heat. Define black body with examples. State the Stefan Boltzmann's law and give. an example of its application. Solve related numerical problems.	The transfer of heat by conduction, convection and radiation Thermal conductivity giving its dimension and units Laws of black body radiation 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
2.6: Gases	**Hrs theory 6**
Objectives	**Contents**
State Boyle's law and Charle's law Define absolute temperature and absolute Zero. State ideal gas equation. Know the value of R.	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.

State and explain Dalton's law of partial pressure. Derive general formula of work done by gas. Define internal energy of gas. State first law of thermodynamics. Define Molar and specific heat capacity of gas. Derive C_p-C_v= R Explain Isothermal and adiabatic changes. Derive expression for pressure exerted by gas. Find expression for *r.m.s*. speed. Solve related numerical problems.	To state and explain Dalton's law of partial pressure. Derivation general formula of work done by gas. Definition of internal energy of gas. Statement of first law of thermodynamics. Definition of Molar and specific heat capacity of a gas. Derivation of C_p-C_v= R Definition of isothermal and adiabatic changes. 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
Unit: 3 Light	**Hrs theory 20**
3.1 Reflection of light	**Hrs theory** 4
Objectives	**Content**
Explain the laws of reflection of light. Find the deviation of light by plane mirrors as rotating mirror. Distinguish between real and virtual image. Show that in a plane mirror object distance = image distance. Define the terms pole, center of curvature, radius of curvature, principal focus, principal axis, focal length. Show that R = 2f for spherical mirrors.	The Phenomenon of reflection and hence state the laws of reflection of light Regular and irregular reflection of light The rotation of light by plane mirror. Object distance is just equal to image distance i. e.u=v but the image is virtual Real and virtual image. Image formation by spherical mirrors. Sign convention for the focal length, object distance and image distance.

Draw ray diagrams to solve problems involving spherical mirrors. Derive the formula 1/u+1/v= 1/f	The relation R=2f, 1/u+1/v=1/f and Manification (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
3.2: Refraction	**Hrs theory 7**
Objectives	**Contents**
State and explain the laws of refraction of light. Verify the laws of refraction of light and define refractive index of different media. Derive the expression for apparent depth and lateral shift in a glass slab. Define critical angle and total internal reflection. Explain the phenomena of total internal reflection. Explain the passage of light rays through a prism. Derive the formula $i+e=A+\delta$ and $A=r_1+r_2$. Define minimum deviation and derive the formula $\mu=\sin(A+\delta_m)/2/\sin(A/2)$. Draw a ray diagram to locate positions of image in thin lenses (concave and convex). Lens formula and lens maker's formula (No derivation).	Phenomenon of refraction. Refractive index in terms of the speed of light in vacuum to the speed of light in medium. The relations ${}_a\mu^g \times {}_g\mu^a=1$. Refractive index in terms of real depth and apparent depth. The relation d=t (1-1/μ) and lateral shift P=t[sin(i-r)]/cosr. Derivation of the formula μ=1/Sinc. Critical angle and conditions for total internal reflection. Examples of total internal reflection phenomena like mirage, light pipe. The formula $A+\delta_m=i+e$ and $\mu=\sin(A+\delta_m/2/\sin A/2$. 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
3.3: Optical Instrument	**Hrs theory 6**
Objectives	**Contents**
Explain defects of vision- Myopia and Hypermetropia. Define angular magnification of telescope. Define astronomical telescope in normal adjustment. Simple microscope- Ray diagram and formula for magnification. Compound microscope – Ray diagram and formula for magnification. Define dispersion of light. Define luminous flux, luminous intensity and illuminance, lumen, lux and candela. State inverse square law of photometry. 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
3.4: Wave theory of light	**Hrs theory 3**
Objectives	**Contents**

Explain wave front and wavelets. State Huygen's principle. Define coherent sources. Define interference, constructive interference and destructive interference. Define diffraction of light. Show formation of interference and diffraction fringes by diagram. Define Polarisation of light.	Explanation of wave front and wavelets. Statement of Huygen's principle. Definition of coherent sources and 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.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
Unit 4: Electrostatics	**Hrs theory 6**
4.1: Electrostatics field	**Hrs theory 6**
Objectives	**Contents**
Concept of electric charge. State modern theory of electrification. State and explain coulomb's law. Explain the properties of lines of force Define electric field and electric flux. Calculate electric field intensity due several point charges Define electric potential difference, potential energy and electron volt. Explain the equipotent surface Explain the zero potential. Define capacitor, its types and uses.	Concept of electric charge. Statement of modern theory of electrification. Coulomb's law for point charges and derivation of the expression for force 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. Electron volt and its use Use of capacitor and its types Definition of capacitance

Define capacitance. Derive E=V/d, for parallel plates capacitor	
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
Unit 5. Wave	**Hrs theory 4**
5.1: Wave motion	**Hrs theory 4**
Objectives	**Contents**
Define damped vibration, forced vibration and resonance. Define longitudinal wave, progressive wave and stationary wave. State progressive wave equation and stationary wave equation. Explain velocity of sound in medium and gas by Newton's formula & Laplace formula (no derivation). Effect of temperature, pressure & humidity on velocity of sound. Define harmonics and overtones. Concept of fundamental frequency and harmonics in organ pipes. State laws of transverse vibration of string. Solve related numerical problems	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
Unit 6: Magnetism	**Hrs theory 10**

6.1: Fundamentals of Magnetism	**Hrs theory 10**
Objectives	**Contents**
Explain magnetic field strength, lines of force, magnetic field intensity and permeability State coulomb's law for magnetism Describe the properties of a magnet Calculate magnetic field intensity due to a bar magnet at any pointy on the equatorial and axial line of a bar magnet. Trace the lines of force and describe their properties. Define natural point. Describe the dip, declination and horizontal components of earth's magnetic field. 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 Dip, declination, horizontal and vertical components of earth's 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
Unit 7: Current electricity	**Hrs theory 16**
7.1: Electric current	**Hrs theory 4**
Objectives	**Contents**
Discuss current as the rate of flow of charge. State and verify Ohm's law. Define resistance and resistivity List the factors that influence resistance of a conductor.	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.

Distinguish between ohmic and non-Ohmic conductors. Find the equivalent resistance from the series and parallel combination of resistors. Perform the conversion of galvanometer into voltmeter and ammeter	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
7.2: Resistance and heat	**Hrs theory 4**
Objectives	**Contents**
State and explain joule's laws of heating. Distinguish between potential difference and *emf*. Relate *emf*, terminal potential and internal resistance. Define joule's conversion factor.	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. Meaning of joule's conversion factor. 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
7.3: Electromagnetism	**Hrs theory 4**
Objectives	**Contents**

Explain Oersted's discovery, direction of current and field. Dependence of force on physical factors. Find force on moving charge. State the principle of moving coil galvanometer. Define electromagnetic induction.. State Faraday's laws of electromagnetic induction. State Lenz's law. State principle and working of a.c. generator. Solve related numerical problems.	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. Principle and working of a.c. generator. 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
7.4: Alternating current	**Hrs theory 4**
Objectives	**Contents**
Describe alternating current (AC) and its interpretation. Relate *rms* and mean value of current and voltage with its peak value. Appreciate that ac meters measures *rms* values only. Explain the principle and working of a transformer and its losses. Describe step up and step down transformers. State faraday's laws of electromagnetic induction.	AC and DC importance of AC over DC. Expression i_{rms}, v_{rms} and i_{mean}, v_{mean} with peak value. Working of a transformer and energy loss mechanisms in transformers. 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
Unit 8: Modern physics	**Hrs theory 22**
8.1: Electrons	**Hrs theory 4**
Objectives	**Contents**
Explain the practical nature of electricity. Discuss the nature, production and properties of cathode rays 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
8.2: Photo electricity	**Hrs theory 4**
Objectives	**Contents**
Define the terms photoelectric effect, photon, wave function, threshold frequency and stopping potential. Explain photoelectric effect on the basis of the quantum theory of radiation. Draw a photoelectric equation. Give the application of photoelectric effect State postulates of Bohr's theory of hydrogen atom.	Photoelectric effect, quantum theory of radiation. Einstein's photoelectric equation $hv=\phi+1/2mv^2$ 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
8.3 X-ray	**Hrs theory 2**
Objectives	**Contents**

Draw well leveled diagram of modern x-ray tube. Explain the production mechanism of x-rays. Discuss the properties of x-rays.	Production and nature of x-rays. 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
8.4: Radioactivity	**Hrs theory 4**
Objectives	**Contents**
Explain the difference between natural and artificial radioactivity List the main properties of α, β and γ radiation. Explain why these forms of radiation have energy on the order of mega electron voltage. Write down the equation for the laws of radioactivity Write down the formula that shows that the relationship n between half-life and decay constant. Graph the decay of radioactivity with time. 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
8.5: Properties of nucleus	**Hrs theory 4**
Objectives	**Contents**
Describe the constituents of a nucleus. Classify different types of nuclei.	The constitutions of nuclei. Isotopes and mass numbers of different elements

Define unified atomic mass units (amu), mass defect, binding energy and binding energy per nucleons, Calculate the mass defect and binding energy of a nucleus Calculate energy equivalence of mass in joules, eVand MeV Explain Einstein's mass-energy relationship theory. Define fission and fusion and calculate the energy released Discuss health hazards and safety related to radiation.	$E=mc^2$ (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.
8.6: Physics and society	**Hrs theory 4**
Objectives	**Contents**
Describe how our environment is being destroyed due to noise pollution, air pollution, soil pollution, thermal pollution, radiation pollution and water pollution Discuss the wide spectrum of electromagnetic radiation form radio waves to cosmic rays. Discuss ozone depletion, greenhouse effect, and acid rain. Discuss strategies to reduce pollution at local and national levels.	Deteriorating conditions of the environment we live in. 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		
Course: Physics Practical		**Hrs lab 64**
Objectives	**Contents**	
Determine the volume of a hollow cylinder and a solid cylinder using vernier calipers.	Volume of hollow and cylinder using vernier calipers	4
Determine the volume of a steel ball using a screw gauge	Volume of steel ball using screw gauge	2
Determine the area of a glass rod using a screw gauge.	Area of glass rod	2
Verify the laws of reflection of light and find the relationship between object distance and image distance.	Laws of reflection of light Relationship between object distance and image distance	6
Verify Archimedes's principle	Verification of Archimedes's principle	4
Determine the specific gravity of solids heavier than and insoluble in water.	Specific gravity of solids heavier than and insoluble in water.	4
Determine the specific gravity and density of substances lighter than water.	Specific gravity and density of substances lighter than water	4
Verify laws of refraction and find the refractive index of glass slab	Laws of refraction and Refractive index	4
Find the focal length of a convex lens by the double pin method.	Focal length of a convex lens	2
Verify the laws of moments of forces and find the weight of a given body.	Laws of moments of forces Weight of a given body	4
Determine the latent heat of fusion of ice.	Latent heat of fusion of ice	4

Determine the magnetic moment and pole- strength of a bar magnet by locating the neutral points, keeping N-pole pointing south and N-pole pointing north.	Magnetic moment and pole-strength of a bar magnet by locating the neutral points	6
Verity Ohm's law by using an ammeter and voltmeter.	Ohm's law	6
Demonstrate the variation of lateral displacement with an angle of incidence in a rectangular slab.	Lateral displacement with an angle of incidence in a rectangular slab	4
Determine the refractive index of a prism using the 1-D curve method.	Refractive index of prism	2
Determine the resistance of given wire by meter-bridge.	Resistance of given wire by meter-bridge.	6
Evaluation methods: written and viva exams, performance observation.	**Teaching /Learning activities and resources:** Class room instruction, demonstration, Observation, illustration, diagrams, visuals, textbooks, and reference books.	

Mathematics

Creadit hours: 6 hrs/week **Full Marks: 100**

Total hours: 160

Course Description

This course in mathematic is designed to provide student to use mathematics skills necessary for application in agriculture. 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 agriculture.
- 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 and 60% accuracy in practical.

Recommended Texts

Bajracharya, D.R., et al., Basic Mathematics, for grade XI and XII National Book Centre, Kathmandu.

DAS & B. C Intermediate trigonometry

Course: Mathematics	**Hrs. theory 160**
Unit1: Mathematics	**Hrs theory**
1.1: Revision on Algebra	**Hrs. theory 16**
Objectives	Contents
Define Sequence and series (arithmetic , geometrics , harmonic) Recall the formulae of A.P., G.P. and H.P.	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.

Define ratio and proportion and their properties. Sum of infinite geometric series. Define Means.	
1.2: Set theory and real number system	**Hrs. theory 18**
Objectives	Contents
Define and denote sets. Types of sets. Find subsets of a set and represent the sets in ven- diagrams. Find the union, intersection, complement and difference of given sets. Solve verbal problems using set operations Define real numbers, absolute value, open and closed intervals and inequalities. Use the concept of set in selected problems. Define a set with given examples. Prove that AU(BUC)= (AUB)UC, where A,B,C are any three non-empty subset. Write the following in set builder form: a) (3,5) b) (-3,9)	The 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. Real number system and the types of numbers, real numbers line, absolute value, open and closed intervals, Inequalities. Try only exercise 1 (1), (2), (3) and (4) 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, diagram classroom instruction, teacher led discussion, demonstration of solutions, illustration through practical examples.
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.
1.3: Function and graph	**Hrs. theory 10**

1.11: Trigonometry	**Hrs Theory 15**
Objectives Find the general values of trigonometric equations. Use practical applications of trigonometry. Solve the problems related to inverse circular functions. Define sine law, cosine law, tangent law, projection law and half angle law. Find the solution of triangle	Contents Trigonometrical equations and general values. Height and distance examples no.1 to 20 from textbook of intermediate trigonometry. 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.

Objectives	Contents
Define a function Classify function Identify the different functions. Sketch a graph of the various functions. Sketch a graph of trigonometric functions.	Functions and their inverse and related problems. Function defined as mapping. Composite functions and related problems. Algebraic, trigonometric, exponential and logarithmic function. Try only exercises II (1), (2), and (3) form 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.
1.5: Quadratic equation	**Hrs.theory 15**
Objectives:	Contents
Define quadratic equation. Find the roots of a quadratic equation. Prove that quadratic equation can not have more than two roots. Find the nature of roots. Find the relation between roots and its co efficients. Formation of a quadratic equation. Find the condition that two quadratic equations have one root common or two roots common.	Defination of quadratic equation. Finding of the roots of a quadratic equation. Proving that quadratic equation can not have more than two roots. Nature of roots. Relation between roots and its co efficients. Formation of a quadratic equation. Find the condition that two quadratic equations have one root common or two roots common.
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.
1.6: Matrices and determinants	**Hrs.theory 15**
Objectives:	Contents
Define the term matrix. Write the rows, columns and order of the matrices. Classify matrices according to their properties. Define the addition and multiplication of matrices (of order m X n, with its different types in 3X3 order). Define a determinant and list the properties of a determinant. Define the terms minors and cofactors. Sarrus rule and expanding rule. Define the transpose and adjoint of a matrix. Define the inverse of a matrix.	Definition of matrix, notation, order, types of matrices and simple algebra of matrices. Construction of matrix. Condition of addition, substraction and multiplication of matrices. 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.
1.7: Coordinate Geometry (Equation of a pair of lines)	**Hrs. theory 20**
Objectives	Contents
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.)	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. Define line pair equation or express two equations of straight lines as a single equation. 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. Prove that the equation ($ax^2+2hxy+by^2=0$) always represents a pair of lines passing through the origin. Find the angle between two straight lines represented by the homogeneous equations of second degree ($ax^2+2hxy+by^2=0$)	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. 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.
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
1.8: limits and Values	**Hrs. theory 15**
Objectives	Contents
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

Use the formula Lt $\frac{X^n - a^n}{X-a}$ $x \rightarrow a$ Lt $\frac{\sin\theta}{\theta} = 1$ (Without Proof) $x \rightarrow \theta$ 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)
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.
1.9 Derivatives and their applications **(Maxima and Minima)**	**Hrs theory 20**
Objectives	Contents
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, $\sin^2 x$, $\cos^2 x$, $\sqrt{sinax}$. 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. 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 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.
1.10: Integration	**Hrs. theory 16**
Objectives	Contents
Define integration(Antiderivative). Apply techniques of integration as anti derivate, substitution method, trigonometric substitution, integration by parts and definite integral. 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.

Chemistry

Credit hours: 4+1 hrs/week **Full Marks: 100**

Total hours: 192

Theory : 128

Practical: 64

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 every day life and to the application of chemistry in Agriculture science. An additional function of the course is to stimulate interest in the application of chemistry and to prepare the student for further study in this field.

Chemistry practical acquaints the student with use of related laboratory equipment and provides practical application of learned theory, which is relevant to Forestry.

Course Objectives

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

1. explain the basic chemical changes involved in chemistry.
2. test the soil to increase the fertility with proper treatment.
3. apply the knowledge of chemistry for the production of improved quality & hygienic food.
4. utilize chemical principles in laboratory testing.
5. explain the photo-chemical responses that occur within the body during illness.
6. apply the theoretical & practical knowledge of phyto-chemistry, which is directly involved in human life.

Minimum Standards

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

Recommended Texts

1. Mitra, Ladli Mohan, A Textbook of Inorganic Chemistry.Ghosh & Co. Current edition.
2. Tuli, G.D. et al., Intermediate Organic Chemistry. S. Chand &Co. Current edition.
3. Jauhar, S.P., Modern ABC's of Chemistry (Vol I&II). Modern Publishers. Current edition

RefereceTexts

1. Jha, J.S., & Gugliani, S.K., A Textbook of Chemistry. Seirya Publication. Current edition.
2. Shamim, A.S., Intermediate Referesher Couse in Chemistry. Vipin Prakasar. Current edition.
3. Sthapit, M. & Pradhanaga, R.R., Fundamentals of Chemistry (Vol I & II). Taleju Prakashar.Current edition.
4. R.D madan Modern Inorganic Chemistry. -S. Chanda & Company.
5. Medicinal Plants in Nepal; RDRL Publication, NG Nepal.
6. Methods in Plant Biochimistry. Vol 6 Acamdemics Press, New York.
7. Leela Dahal, A Study on Pesticide Pollution in Nepal -IUCN, NCS Implementation project.
8. Basic Food Chemistry- Lee, Avi Publication
9. William Honag Land Meyer Food Chemistry -CBS Publishers & Distributors, Ist Indian edition-1987.
10. Soil Science.
11. N.K Vishnoi Advanced Practical Organic Chemistry.- Second revised edition Vikas Publishing Pvt-Ltd.

Course: Chemistry	**Hrs. theory 128** **Hrs. lab 64**
Unit 1: Physical Chemistry	**Hrs. theory 47**

Elements, compounds and chemical change	**Hrs. theory 3**
Objectives	Contents
1. List the symbols of elements. 2. Identify monovalent, divalent, trivalent elements and radicals. 3. List the information conveyed by symbol and formula 4. Identify physical and chemical change. 5. Identify the suitable process for separating constituents of a mixture. Q. What are the differences among H^+, H^-, H_2, $2H_2$, and 2H? Q. Write the molecular formula of potassium Ferro cyanide sodium peroxide.	Symbols for the atom, molecule, and compound radical and variable valency Writing, a chemical formula Significance of symbols and formulas Molecular and empirical formulas Difference between chemical compound from mechanical mixture Pure and impure substances
Evaluation methods: Written exam, oral and written assignments, performance observation in lab.	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration-Reaction of sodium on water.
1.2: Chemical equations	**Hrs. theory 3**
Objectives	Contents
1. Construct a graphical representation of the relationship between amount of reactant and product with time. 2. Describe ways to make the equation more informative. 3. Demonstrate how to balance a chemical equation. 4. Explain any seven types of reaction with two examples of each. 5. Tell whether mass is conserved or not in the examples above.	Chemical equation, reactant and product Significance and limitations of chemical equations Ways of making chemical equations more informative Type of chemical reactions (seven-types) with examples Balancing a chemical equation by

Q. What is the quantitative significance of a chemical equation?	A. trial and error method B. Partial equation method
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities or resources :** Theoretical explanation, Classroom instruction exercises, Demonstration-Reaction of a piece of zinc with excess acid
1.3: Periodic table	**Hrs. theory 4**
Objectives	Contents
1. Identify the location of s, p, d, and f block elements. 2. Define atomic radii, electro-negativity IP, EA. 3. Identify alkali and alkaline earth metals, halogens, noble gases, transition metal, and radioactive elements and indicate their location. 4. State Mendeleef's periodic law Q. which one, Cl or Br, is more electronegative and why?	Modern periodic classification of elements. Location of s, p, d, f-block elements Periodicity in properties by: Q. Atomic radii (ii) Electro negativity (iii) Ionization potential (iv) Electron affinity Definition of Mendeleef's periodic law, advantage and anomalies of periodic table and modern periodic law.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration-Reaction of a piece of zinc with excess acid. Chart display: Long and short form of periodic table.
1.4: States of matter-Gaseous state	**Hrs. theory 3**
Objectives	Contents
1. Compare the volume of gas at different conditions (pressure and temperature) 2. Compare the rates of diffusion of different gases.	Effect of pressure and temperature on volume of gas Boyle's law, Charles'slam combined gas lawa, daltion law of partial pressure

Q. Which one, CO_2 or SO_2, diffuses faster and why?	Simple derivation of ideal gas equation (PV=nRT) Diffusion of gas NTP or STP Kinetic theory of gases Related simple problems.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration-Reaction of a piece of zinc with excess acid.
1.5: States of matter-Liquid State	**Hrs. theory 3**
Objectives	Contents
1. Define solubility and solve problems based on solubility 2. Define viscosity and surface tension Q. Why water can flow more easily than honey?	Unsaturated, saturated and supersaturated solution Solubility, Solubility charge and related numerical problems
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, demonstration-compare
1.6: States of matter-Solid State	**Hrs. theory 3**
Objectives	Contents
1. Define amorphous and crystalline solids and give examples. 2. List the examples of crystalline, deliquescent, hygroscopic, efflorescent, Isomorphism, liquid crystal and substances.	The deference between amorphous and crystalline solids Water of crystallization, deliquescent, hygroscopic, efflorescent, Isomorphism structure of NaCl crystal

Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, demonstrateion-FeCl3 exposed to air, blue vitriol heated.
1.7: Atomic Structure - State	**Hrs. theory 3**
Objectives	Contents
1. Define electron, proton & neutron with their charge and mass. 2. List the postulates of Bohr's atomic model. 3. Design electronic configuration of elements (up to Z=30) 4. Define radioactive decay with common examples. 5. Explain the use of radiation in the field of forestry. 6. Describe the pollution due to radioactivity.	Charge and mass of fundamental particles of atoms Rutherfords and Bohr's atomic model Shell, sub-shell and orbital (s, p, d, f) How atoms are arrangement of electrons in orbits (Aufbau principle) Atomic number, mass number, atomic weight and gram atomic weight Isotopes and isobars.
Evaluation methods: written exam, oral and in lab and Written assignments, performance observation	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
1.8: Electronic theory of valency	**Hrs. theory 3**
Objectives	Contents
1. Define valence electron, duplet, octet and noble gas electronic configuration. 2. Describe the Lewis structure of different molecules. 3. List the properties of electrovalent, covalent and co-ordinate covalent bond. Q. Why is ammonia readily soluble in water?	Valence electron, duplet, octet and Noble gas electronic configuration The mode of formation and properties of compounds Electrovalent Covalent Co-ordinate covalent Polar and non-polar covalent bond and compound

	Types and effect of Hydrogen bond
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
1.9: Oxidation and Reduction	**Hrs theory 2**
Objectives	Contents
1. Identify oxidation half, reduction half, oxidant and reductant.	Classical and electronic concept of oxidation and reduction. Oxidant and reductant and oxidation number Importance of oxidant, reductant in Biological process, sterilization and disinfection, bleaching and spot removal. Examples of redox reaction Balancing a redox reaction by i) oxidation number method ii) Ion-electron method
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
1.10: Electrochemistry	**Hrs. theory 5**
Objectives	Contents
1. Differentiate between (i) Electrolytes and non-electrolytes (ii) Strong electrolytes and weak electrolytes (iii) Ions and atoms. 2. Describe the variation of degree of ionization 3. State and explain common ion effects 4. State briefly Faraday's laws of electrolysis 5. Compute the pH of neutral water above and below 25^{o}C	Electrolytes, Non-electrolytes, strong and weak electrolytes Arrhenius theory of ionization Degree of ionization, Faraday's laws of electrolysis Electrolysis of water Ionic product of water, pH. pOH Buffer solution and mechanism of buffer action Importance of pH and buffer in human body

6. Define buffer solution (acidic and basic) 7. Solve numerical problems related with pH acidic or basic solutions Q. Explain why NaCl becomes ionized in water while glucose does not	
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
1.11: Acid, base and salt	**Hrs. theory 5**
Objectives	Contents
1. Compare general properties of acid, base and salts. 2. Define weak and strong acid and base. 3. Define neutralization. 4. List the deferent types of salts. 5. Identify the nature of salt solution. 6. Identify the requirements for the substance to be antacid and ant abase.	Characteristics of acid and base. How acid neutralizes carbonate and neutralization of carbonate or bicarbonate by acid Theories of acids and base i) Arrlenilus theory ii) Bronsted-lowery theory iii) Leuis's Theory Various types of salts Nature of aqueous solution of salts. Antacids and antabases and their medical uses Examples of acid and base in plants and their roles
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration-reaction between: carbonate and acid, acid and base
1.12: Solutions-True solution	**Hrs. theory 3**
Objectives	Contents
1. Define osmosis, reverse osmosis, osmotic pressure, and isotonic, hypotonic and hypertonic solutions.	Dilute and concentrated solution

2. Explain the importance of osmosis ephemeron.	Diffusion of solute in solution, osmosis, osmotic pressure isotonic, hypotonic and hypertonic solution Biological importance of osmosis
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
1.13: Mole concept and chemical arithmetic	**Hrs. theory 3**
Objectives	Contents
1. Relate number of mole with gram molecular weight, number of particles and volume occupied (for gas). 2. Identify limiting and excess reagent. 3. Estimate the amount of reactant required and product formed in any reaction. Q. What volume of oxygen at NTP is required to oxidize 10-gram glucose and volume of CO_2 will be formed?	Mole and Avogadros' number. Determination of percentage composition. Numerical related to the following relationships based upon chemical equation - Mass-Mass relationship Mass-volume relationship Volume-volume relationship Calculation based on limiting reagent.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
1.14: Volumetric analysis	**Hrs. theory 4**
Objectives	Contents
1. Define different units of concentration and show their relation. 2. Prepare standard solution of desired concentration and solve problems on dilution. 3. Solve different numerical regarding acidimetry and alkalimery.	Equivalent and gram equivalent weight of element, acid, base, and salt Titration, acidimetry, alkalimetry, end point, indictor, primary standard substance Ways of expressing concentration of solution in terms of

	i) Normality ii) Molarity iii) Molality and %. Normality equations Calculations to prepare different concentrations of solution
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
Unit 2: Organic Chemistry	**Hrs theory 35**
2.1: An introduction to organic Chemistry	**Hrs. theory 3**
Objectives	Contents
1. List the difference between organic and inorganic compounds. 2. List the importance of organic compounds in medicines and drugs with common examples. 3. Role of forest product in medicine. 4. Scope of organic chemistry for Agriculture	1. Origin of organic chemistry-Vital force theory and modern theory 2. Difference between organic and inorganic compound 3. Sources of organic compound 4. Importance of organic compound in Agriculture (i) Antipyretics (ii) Analgesics (iii) Antibiotic (iv) Antimalarials (v) Tranquilizers (vi) Germicides (vii) Antiseptic found in plants.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.2: Nomenclature of organic compounds	**Hrs. theory 4**
Objectives	Contents
1. Tell the reasons for large number of organic compounds. 2. Classify the organic compounds into various types.	Reason for large number of organic compounds- Tetrvalency

3. Describe fictional group with different examples. 4. Describe characteristics of homologue. 5. Use the IUPAC system for nomenclature. Q. Write down the name and structure of the following functional groups: $CONH_2$, COOH	Catenation property Isomerism Various types of organic compounds with their examples Functional group and its various types Homologous series with examples Prefix, primary suffix, secondary suffix, and principal functional group Naming aliphatic and aromatic compounds with IUPAC systems. Detection of foreign elements N,S and X
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.3: Isomerism	**Hrs theory 3**
Objectives	Contents
1. Describe the different kinds of structural…. 2. Explain choral optically active substance.	Definition of isomerism. Structural isomerism of the types- (i) Positional (ii) Functional (iii) Metamerism (iv) Chain isomerism
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.4: Organic reaction	**Hrs. theory 4**
Objectives	Contents
1. Identify the nature of reaction. 2. Create concept about writing mechanism of simple reactions.	Carbocation and carbanion. Inductive effect (+1 and -1 effect)

Q. What are attacking reagents? Give two examples of each.	Homolysis and heterolysis bond fission. Electrophones and Nucleophiles. Resonance. The types of organic reactions-Electrophonic and nucleophilic substitution, addition, elimination.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.5: Hydrocarbons	**Hrs Theory 4**
Objectives	Contents
1. Describe the isomerism in alkane. 2. Describe the substitution in alkenes. 3. Describe the knocking of fuel.	The physical properties of alkanes (only methane) Chemical properties-halogenation combustion, phyrolysis Uses in everyday life
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
Lesson: B. Alkene	Hrs theory 2
Objectives	Contents
1. Describe the addition reaction. 2. Describe the test of alkene.	Laboratory preparation of ethane from ethanol The physical properties. The chemical properties-Combustion, halogenation, with Br_2 solution, with halogen acid (Test of double bond), with Baeyer's reagent, polymerization, ozonolysis Markovnikov's rule

Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
Lesson: C. Alkyne	Hrs. theory 2
Objectives	Contents
1. Describe the addition reaction in alkyne. 2. Explain the acidic nature of alkyne. 3. Describe the test of alkyne	Laboratory preparation of ethyne from calcium carbide. Physical properties of acetylene Chemical properties-Combustion, hylogenation, catalytic hydration, with Br_2 solution, with Na, with tollens reagent, with Bayer's; reagent, ozonlysis polymerization, with Cl_2 Markovnikov's rule. Uses of ethyne in life
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.6: Alkyl halides	**Hrs. theory 1**
Objectives	Contents
1. List the properties and uses of ethyl iodide. 2. Introduction of alkyl halides	1. Definition of alkyl halides. With example. 2. uses of alkyl halides
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.7: Alcohol	**Hrs. theory 3**
Objectives	Contents
1. Classify alcohols 2. Explain the process of fermentation.	Classification of alcohol as- monohydric, dihydric, polyhydric, primary, secondary and tertiary Identification of primary, secondary and tertiary alcohol by oxidation method

	Physical properties of ethanol Chemical properties- Oxidation, with sodium, with oxygen, with H_2SO_4, CH_3COCl, CH_3COOH, combustion
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.8: Carbonyl compound	**Hrs Theory 3**
Lesson: A Formaldehyde & Acetaldehyde	Hrs. theory 2
Objectives	Contents
1. Describe the physical and chemical properties of formaldehyde. 2. List uses of formaldehyde.	General methods of preparation Physical properties. Chemical properties-with ammonia, with NH_4OH, NaOH, Polymerisation. Uses in everyday life.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
Lesson B. Acetone (Ketone)	Hrs. Theory 2 Hrs. lab
1. Identify ketonic compounds. 2. Describe the physical and chemical characterstics of ketonic compound. 3. List the uses of ketonic compounds.	Preparation from isopropyl alcohol and Ca-acetate Physical properties Chemical properties with $NaHSO_3$, Phenyl hydrazine Uses in everyday life
2.9: Carboxylic acid Acetic Acid	**Hrs theory 2**
Objectives	Contents

1. Identify the homologue of aliphatic nomocarbocyhlic acid. 2. Describe the physical properties of acids (solubilty, acidic character). 3. Describe the uses of vinegar. Q. Write down the uses of acetic acid.	Preparation from acetylene and ethanol Physical properties Chemical properties with-$NaHSO_3$, NH_3, C_2H_5OH, PCl_5 and reduction, acidity of carboxylic acid Uses in everyday life Uses of formic acid in everyday life Natural sources of acetic acid
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration
2.10: Amines.	**Hrs. theory 2**
Objectives	Contents
1. Identity the organic bases. 2. Identify the 1, 2 and 3 amines and their names.	Nomenclature and classification of amines Basicity of amines Examples of amines
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
2.11: Phenol	**Hrs. theory 3**
Objectives	Contents
1. Prepare phenol from benzene diazonium chloride and sodium benzene sulphonate. Explain action with Na, Zn, NH_3, benzenediazonium chloride kolbe's reaction.	Preparation from benzene diazonium chloride and sodium benzene sulphonate, physical properties. Action with Na, Zn, NH_3, benzenediazonium chloride kolbe's reaction.

Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
2.12: Natural Products chemistry	**Hrs. theory 3**
Objectives	Contents
1. make a list of medicinal plants. 2. Introduction of phytochemical techniques 3. define alkalides, steroids, and antibiotics.	List of Medicinal Plants in Nepal Phytochemical Technique; Extraction, Isolation, Purification, and charaterisation of Natural products Introduction about alkaloids, steroids, antibiotics
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.

Unit 3: Organic Chemistry	**Hrs. theory 9**
3.1: Ether	**Hrs. theory 2**
Objectives	Contents
1. Identify homologue of ether with their common and IUPAC name 2. Describe the physical and chemical properties	Lab preparation of diethylether from ethanol Physical properties Chemical Properties with Combustion, hydrolysis, reaction with HI and PCl_5 Uses in medicine and everyday life
Evaluation Methods: Written tests, home assignments, Performance observation (interaction and participation in the class)	**Teaching/Learning activities and recourses:** Classroom instruction, problem solving exercise and demonstrations
3.2: Aromatic Compounds	**Hrs. theory 6**

Lesson: A. Introduction	**Hrs. Theory 3**
Objectives	Contents
1. Define aromatic compound &List the characteristics. 2. Identify the name of aromatic compounds and some heterocyclic compounds.	Aromatic compounds Nomenclature of benzene derivatives (Mono, di and tri-substituted) To define heterocyclic compounds. Characteristics of aromatic compounds Differences between aliplatic and aromaticlomped Nomenclature and examples of different aromatic compounds
3.3 : Food Chemistry.	**Hrs. Theory 1**
Objectives.	Contents.
To make lists of hygienic foodstuffs.	Definition and advantage of Food Chemistry.
Evaluation methods: written exam, oral and written assignments, performance observation in lab	**Teaching/Learning activities and resources:** classroom instruction, theoretical explanation, problem solving, and demonstration.
Lesson: B. Benzene	Hrs. Theory 1
1. Describe the preparation, properties and uses of Benzene	prepare atiob of benzene Kekule structure of benzene Physical properties of benzene Chemical Properties- Halogenations, nitration, sulphonation, Friedal craft's reaction, Combustion and hydrogenation Uses in everyday life

Evaluation Methods: Written tests, home assignments, Performance observation (interaction and participation in the class)	**Teaching/Learning activities and recourses:** Classroom instruction, problem solving exercise and demonstrations
Unit 4: Environmental Chemistry	**Hrs. theory 4**
4.1: Pollution	**Hrs. theory 4**
Objectives	Contents
Define Environment Define the Environment related terminology Pollutant, Receptor, Sink, Speciation, Threshold Limit value (TLV) Describe why environment is getting polluted Define acid rain and Identify the causes of Acid rain Describe the treatment of domestic waste List the negative effects of radiation, ozone layer depletion and green house effect	The sources and adverse effects due to the following air pollutants- CO_2, SO_2, H_2S, Co, Hydrocarbon, Lead, cadmium dust, EFC, Oxides of nitrogen Indoor air pollution Effects of air pollution on -human health, materials and climate Pollutants of acid rain Adverse effects of acid rain Mode of water pollution Water pollutants- inorganic pollutants organic pollutants, domestic waste, , industrial and agricultural waste, fluorides Effect due to water pollution Effect due to radioactivity Green house effect
Evaluation Methods: Written tests, home assignments, Performance observation (interaction and participation in the class)	**Teaching/Learning activities and recourses:** Classroom instruction, problem solving exercise and demonstrations
Unit 5 :Inorganic Chemistry	**Hrs. theory 30**
5.1: Water	**Hrs. theory 3**
Objectives	Contents
1. Explain the hardness of water	Soft and hard water

1. Describe the chlorination of water 2. List advantage and disadvantage of hard water 3. Explain the method of purification of drinking water 4. Define degree of hardness of water 5. Define heavy water	The process of removal of hardness: -Boiling, Clark's process using washing soda, permutit process, soda-ash method, deionization of water The advantages and disadvantages of hard water The meaning of drinking water Methods of purification of drinking water by boiling, candle filtration, chemical disinfection, bleaching powder, Cl_2 solution, iodine, $KMnO_4$ ozonisation, using potash alum The solvent property of water
Evaluation methods: written tests, written assignments, performance observation	**Teaching/Learning activities and resources:** classroom instruction, problem solving exercises, demonstrations
5.2.: Metals	**Hrs. theory 6**
Objectives	Contents
1. Distinct between metals and non-metals 2. Describe ores and materials, occurrence of metals. 3. Describe general metallurgy of metals. (crushing and dressing) 4. Describe Calcinations and roasting, reduction with carbon. 5. Describe purification (distillation and electro refining) 6. Describe about sodium 7. Describe about physical properties of copper 8. Describe about Zinc	Characteristic of metals and non-metals Occurrence of metals. General metallurgy of metals. (crushing and dressing) Calcination and roasting, reduction with carbon. Purification (distillation and electro refining) Sodium: physical properties, action with air, water, non-metals NH_3. Physical properties of copper, action with H_2SO_4, HNO_3, and short notes on bluevitrol. Zinc, physical properties, action with HCl, HNO_3, H_2SO_4, water, air and alkali, galvanization. Iron : physical properties action with HCl, HNO_3 , H_2SO_4, water, halogen, rusting.

9. Describe about Iron	
Evaluation methods: written tests, written assignments, performance observation	**Teaching/Learning activities and resources:** classroom instruction, problem solving exercises, demonstrations
5.3.: **Acids and fertilizers**	**Hrs. theory** 6
Objectives	Contents
1. Define and formation of Nitric Acid: 2. Describe Nitrogen cycle and causes of acid rain 3. Describe NPK fertilizer. 4. Explain pesticide 5. Explain Sulphuric acid 6. Explain Hydrochloric acid	Nitric Acid: Ostwald process. (principle with diagrammatic sketch.) Physical properties, acidic character, action with carbon, sulphur, H_2S, SO_2. Action with $FeSO_4$, Mg, Zn, copper, ring test. Nitrogen cycle and causes of acid rain NPK fertilizer, characteristics, natural and artificial fertilizer, examples and need of NPK fertilizers. Pesticide insecticide, rodenticide herbicide, fungicide and their examples. Sulphuric acid: contact process (no description) Physical properties, dehydrating action with Zn, Cu, salts, oxidising agents. Hydrochloric acid: physical properties, acidic nature, action with ammonia, silver nitrate, salts and uses.
Evaluation methods: written tests, written assignments, performance observation	**Teaching/Learning activities and resources:** classroom instruction, problem solving exercises, demonstrations
5.4.: Non metals	**Hrs. theory 6**
Objectives	Contents
1. Explain Hydrogen - physical properties and reaction. 2. Explain Oxygen-physical properties, and reaction 3. Explain Carbondioxide- physical properties and reaction.	Hydrogen- physical properties, reaction with O_2, Na, Ca, X_2, N_2, vegetable oil, uses, heavy water, isotopes of hydrogen. Oxygen-physical properties, reaction with C, Ag, Na, H_2, SO_2, NH_3, N_2, uses.

4. Explain Ammonia and manufacture by haber's process. 5. Explain physical properties, chemical properties with H_2O, O_2, Na, AgCl, $CuSO_4$, nessler's reagent and uses. 6. Describe general characteristics of halogens	Carbondioxide: physical properties, reaction with Na, Mg, H_2O, lime water, carbon, iron, and uses. Ammonia: manufacture by haber's process.(principle with diagrammatic sketch.) Physical properties, chemical properties with H_2O, O_2, Na, AgCl, $CuSO_4$, nessler's reagent and uses. General characteristics of halogens
Evaluation methods: written tests, written assignments, performance observation	**Teaching/Learning activities and resources:** classroom instruction, problem solving exercises, demonstrations
5.5.: Minerals	**Hrs. theory 3**
Objectives	Contents
1. Describe the need of minerals 2. Find their sources and importance.	Sources of the followings minerals-Na, K, Ca, Mg, Fe, Zn, Ni, Cobalt Biological importance and effects due to their deficiency
Evaluation methods: written tests, written assignments, performance observation	**Teaching/Learning activities and resources:** classroom instruction, problem solving exercises, demonstrations
5.6: Chemical fertilizers	**Hrs. theory 3**
Objectives	Contents
Use the chemical fertilizer effectively	Chemical fertilizers NKP Fertilizers. Role of Fertilizers in plant or vegetation Advantage and disadvantage of chemical fertilizer.
5.7: Cycles and Elements	**Hrs. theory 3**
Objectives	Contents

Identify of Natural cycles or green house effect.	i) Oxygen Cycle ii) Nitrogen Cycle iv) Carbon Cycle and v) Water cycle

Chemistry Practical

General Chemistry-Practical	**Hrs Lab 8**
Practical 1. Introduction	Hrs. lab 5
Objectives	*Contents*
1. Follow stated laboratory procedures and guidelines 2. Describe safety and first aid measures for the chemistry lab 3. Demonstrate the methods for chemistry lab documentation	Procedural rules and guidelines of the chemistry lab Proper handling of equipment Lab safety measures Documentation procedures for laboratory work
Evaluation methods: Written and viva exams, performance observation in laboratory settings.	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
Practical 2 Use of Bunsen burner	**Hrs. lab 3**
Objectives	*Contents*

1. Identify the names and functions of the parts of a Bunsen burner. 2. Describe the correct use of the Bunsen burner and its flame with: • airs holes closed. • with airs holes open Differentiate between the uses of oxidizing and non-oxidizing flames.	The correct operation of the Bunsen burner. Parts of the Bunsen burner Oxidizing and non-oxidizing flames
Evaluation methods: Written and viva exams, performance observation in laboratory settings.	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
Practical 3. Simple lab operation	**Hrs. lab 6**
Objectives	*Contents*
1. Separate sand and common salt in pure and dry states from mixture of sand and common salt. 2. Separate sand and camphor from a mixture of sand and camphor 3. Recover the precipitate obtained in pure and dry state when the given solution -A is treated with excess of solution-B i. Solution-A= $BaCl_2$ ii. Solution-B =H_2SO_4 4. Prepare a sample of clearly pure distilled water from impure water and carry out the test for purity of water thus prepared. 5. Prepare a sample of bazaar copper sulphate at laboratory temperature and use the solution to get pure crystals of salts. 6. Obtain sodium chloride by the neutralization of: i. Bench of hydrochloric acid with a bench of sodium hydroxide. ii. Sodium carbonate with hydrochloric acid 7. Prepare a soluble derivative of barium carbonate and sodium chloride	The process and methods of filtration Characteristics of filtrate and residue Chlorides ion test. Nature of mixtures and components Principles and processes of sublimation Characteristics of sublimation Characteristics of precipitation Principles and process of precipitation. The distillation process Properties of pure water Characteristics of saturated solutions Crystallization point and crystallization process

	Acid base reactions The principles and process of evaporation. Characteristics of soluble and insoluble salts
Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
2. Inorganic Chemistry-Practical	**Hrs Lab 12**
Practical 1. Preparation of gases	Hrs. theory Hrs lab 6
Objective	Contents
1. Prepare hydrogen, ammonia and carbon dioxide gases. 2. Identify the properties of hydrogen, ammonia and carbon dioxide gases.	1. Use of apparatus required for gas experimentation 2. Chemicals used in gas experimentation. 3. Physical and chemical properties of selected gases
Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
Practical 2. Salt analysis	Hrs. theory Hrs. lab 6
Objectives	Contents
1. Perform salt tests for acid radicals by dry and wet methods.	1. Procedures for identification of acid radicals in salt.

Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
3. Physical Chemistry-Practical	**Hrs Lab 8**
Practical 1: Equivalent weights	Hrs. theory Hrs. lab 4
Objectives	Contents
1. Use a chemical balance to weigh various substances. 2. Determine the equivalent weight of a given metal by the hydrogen displacement from acid method	1. The operation of a chemical balance scale 2. The meaning of equivalent weight 3. Calculation of equivalent weights
Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
Practical 2 Acidimetry and alkalimetry	**Hrs. theroy Hrs lab 4**
Objectives	Contents
1. Standardize the given acid, which is approximately decinormal. 2. Determine the strength of alkali with the help of a standard acid supplied. 3. Determine the strength of acid in terms of: a. Normality b. Grams/liter c. Percentage	1. Process of titration 2. Acidimetry and alkalimetry 3. Known and unknown solutions 4. Substances with primary and secondary standards 5. Preparation of solutions of various strengths 6. Calculation of strengths of unknown solutions in terms of normality, molarity, molarity, gram/liter, and percentage

Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources: C**lassroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving
4. Organic Chemistry-Practical	**Hrs lab 8**
Practical 1. Element detection	Hrs. theory Hrs lab 4
Objectives	Contents
1. Detect the elements present in given organic compounds.	1. Process for detection of nitrogen, sulphur, halogens. 2. Selected chemical tests.
Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.
Practical 2: Identification of organic compounds	Hrs. theory Hrs. lab 4
Objectives	**Content**
1. Identify given organic compounds	1. The identification of acetate, formate, formaldehyde, oxalate, oxalic acid, glycerol, acetone, ethyl alcohol, acetic acid, formic acid 2. Selected chemical tests
Evaluation methods: Written and viva exams, performance observation in laboratory settings	**Teaching/Learning activities and resources:** Classroom instruction, textbook self-study, demonstration and return demonstration, laboratory practice problem solving.

Food Chemistry Practicals

Course: Chemistry Practicals	**Hrs .lab 22**
Practical 1: Identification of Agriculture products containing carbohyderate, protein and lipids	**Hrs. lab 6**
Objectives	*Contents*
Prepare the list of Agriculture products containing carbohydrate, protein and lipids	• Making a list and identification of the Agriculture product containing carbohyderate, protein and lipids.
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Practical 2: Techniques of phytochemical screening	**Hrs. lab 6**
Objectives	*Contents*
Describe different techniques on phytochemical screening of some medicinal plants	• Simple techniques discussion on phytochemical screening of some medicinal plants
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Practical 3: Listing medicinal plants and their uses	**Hrs.5 lab**
Objectives	*Contents*
Make a list of some medicinal plants and their extracts and their biological uses	• Making a list of some medicinal plants their extracts and biological uses
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Practical 4: P4 value of the soil	**Hrs. 5 lab**
Objectives	*Contents*
Find the values of the given sample of the soil	• To find the PH value of the given sample of the soil.
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.

Botany

Credit hours: 4+1 hrs/week **Full Marks: 100**

Total hours: 192

Theory: 128

Practical: 64

Course Description:

This course aims at providing basic knowledge of Botany to certificate level students of Agriculture. The course is divided into nine units. The first unit gives introduction of botany. The second unit provides information about molecules of living systems. The third unit provides information on plant anatomy. Unit four is about physiology, which covers knowledge about membrane transport, transpiration, photosynthesis and respiration. Unit five gives the concept of taxonomy, classification and biodiversity and it also provids information about organisms like virus, bacteria, cyan bacteria, and bryophytes, pteridophytes, gymnosperms and angiosperms. The sixth unit gives information about embryology of angiosperms. The seventh unit tells about different aspects of genetics. The eighth unit gives introduction to economic and ethno botany. Unit ninth gives the account of biotechnology including tissue culture and genetic engineering. This chapter also focuses on morphology of five common taxonomic families.

Course Objectives:

After completing this course the students will be able to:

- Understand scope of botany, its different branches, and interrelation of botany with other sciences.
- Understand the structure of plants at molecular, cellular, tissue and organ level of organization.
- Understand basic principles of genetics biotechnology and plant breeding.
- Understand basic anatomical features and physiological process in plants.
- 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.
- Explain different aspects of embryology of angiospermic plants.
- Know identifying features with their economic importance.
- Identify some important medicinal plants of Nepal and their uses.
- Explain about ethnobotany and its importance.

Minimum Standards:

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

Recommended Textbooks:

Dutta, A. C. *A Class book of Botany*. Oxford University Press, Calcutta.

Bhattia K. N. and Khanna. *Modern Approach to Botany.* Surya Publications, Jalandhar, India.

Pandey, S. N. and P. S. Trivedi. *A Textbook of Botany* (Vol 1). Vikas Publishink House Pvt Ltd, New Delhi, India.

Pandey, S. N. and P. S. Trivedi. *A Textbook of Botany* (Vol 2). Vikas Publishink House Pvt Ltd, New Delhi, India.

Pandey, B. P. *Taxonomy of Angiosperms.* Chand and Company Ltd, New Delhi, India.

Sinha, V. and S. Sinah. *Cytogenetics Plant Breeding and Evolution.* Vikas Publications Ltd , New Deldi.

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

Keshari, A. K. and K. K. Adhikari. *A text Book of Higher Secondary Biology (Class II).* Vidyarthi Pustak Bhandar, Kathmandu.

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*

Reference Books

Chaudhary, R. P. *Biodiversity in Nepal Statud and Conservation.* S. Devi, Saharanpur (U. P.), India and Tecpress Books, Bangkok, Thailand.

Pandey, B. P. *Plant Anatomy.* S. Chand and Company Ltd, New Delhi, India.

Pandey, B. P. *Economic Botany.* S. Chand and Company Ltd, New Delhi, India.

Alexopolos, C. J. *Introductory Mycology.* John Wiley and Sons, New York.

Vasishta, P. C. *Botany for Degree Students (vol 5) Gymnosperms.* S. Chand and Company Ltd, New Delhi, India.

Lawerence, C. H. M., *Taxonomy of Vascular Plants.* McMillan Company.

Bhojwani S. S. and S. P. Bhatnagar. *The Embryology of Angiosperms.* Vikas Publication, Delhi, 1993.

Dubey, R. C. *A Textbook of Biotechnology.* S. Chand and Company Ltd, New Delhi, India.

Jain, V. K. *Fundamentals of Plant Physiology.* S. Chand and Company Ltd, New Delhi, India.

Jain, J. L. *Fundamentals of Biochemistry.* S. Chand and Company Ltd, New Delhi, India.

HMG, Nepal. *Medicinal Plants of Nepal.* DPR, HMG, Nepal.

Toylor D.J., N.P.O. Green and G.W.S Stout. Biological science (Third Edition). Cambridge University Press.

Course: Botany	**Theory: 128 hrs Practicle 64 hrs**
Unit 1: Introduction to Botany	**Theory: 4 hrs**
1.1 Definition and Scope of Botany	**Theory: 4 hrs**
Objectives	Contents
Define Botany. Explain the importance of Botany. Explain the importance of plants. List and define major branches of botany on the basis of field of study and plant groups. Describe the interrelationship between different branches of Botany. Discuss the relation of Botany with other sciences like Physics, Chemistry, Statistics, etc.	Definition of Biology and Botany Definition of plants Importance of Plants Scope and importance of Botany Different branches of Botany and their interrelationships Relationship of Botany 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: 12 hrs**
2.1 Life Components	**Theory: 1 hrs**
Objectives	**Contents**
Define the terms cellular pool, biomolecules, micro-molecules and macromolecules with examples. List inorganic and organic molecules of the living system. Define monomers and polymers with examples.	Definition of cellular pool, biomolecules, micro and macromolecules, inorganic and organic molecules and monomers and polymers with examples.
Evaluation:	**Teaching Methods:**

Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	Classroom instruction, textbooks, reference books, charts, diagrams, photographs, show items containing relevant biomolecules.
2.2 Water	**Theory:2 hrs**
Objectives	Contents
Give structure and properties of water. 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
Define carbohydrates. Define glycosidic bond. Define monosaccharide, oligosaccharides, and polysaccharides with examples. Define sugars and non-sugars. List functions of carbohydrates.	Definition, types, examples, and functions 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

Define proteins as polypeptides. Define essential and non-essential amino acids with examples. Define peptide bonds. Define primary, secondary and tertiary structure of protein. Define denaturation of or proteins. List functions of proteins.	Definition, types, examples, and functions 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**
Objectives Define lipids as triglycerides. Define saturated and unsaturated fatty acids. Differentiate fats and oils. Define phospholipids. List functions of Lipids.	Contents Definition, types, examples, and functions 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: 3 hrs**
Objectives	Contents

Define nucleic acids as polynucleotides. List components of Nucleotides. Define phosphodiester bond. Define and differentiate DNA and RNA. List function of Nucleic acids.	Definition, types, examples and functions of Nucleic acids Definition glycosidic, peptide and phosphodiester bonds.
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: Plant Anatomy	**Theory: 16 hrs**
3.1: Tissue and its types	**Theory: 8 hrs**
Objectives:	Contents
Define tissue Classify tissues as Meristematic, Permanent and Secretory List features of Meristematic tissues Give types of Meristematic tissues with examples Define permanent tissues Classify permanent tissues as simple and complex List basic features, distribution and function of different simple and complex permanent tissues Define secretory tissues Give types of secretary tissues, their examples and importance. Define primary and secondary tissues.	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.

List and define types of Xylem- protoxylem and metaxylem; exarch, endarch, mesarch and centrarch. Define vascular bundles and their elements- xylem, phloem and cambium. Identify ypes of vascular bundles- radial, conjoint (collateral, bicollateral and concentric); open and closed.	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.
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.
3.2: Internal structure of dicot and monocot root and stem.	**Theory: 4 hrs**
Objectives	Contents
Describe internal structures of dicot and monocot stems. Describe internal structure of dicot and monocot root.	Internal structures of dicot and monocot stems Internal structure of dicot and monocot root.
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.
3.3: Anatomy of Dorsiventral and Isobilateral leaves	**Theory: 2 hrs**
Objectives	Contents
Describe internal structures of dorsiventral leaves. Describe internal structure of isobilateral leaves.	Internal structures of dorsiventral leaves. Internal structure of isobilateral leaves.

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.
3.4: Secondary growth	**Theory: 2 hrs**
Objectives	Contents
Define secondary growth. Discuss the role of cambium and cork cambium in the secondary growth of dicot root and stem. Define annual rings and discuss how they are formed.	Definition of secondary growth. Role of cambium and cork cambium in the secondary growth of dicot root and stem. Annual rings and their formation.
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.
Unit4: Plant Physiology	**Theory: 16 hrs**
4.1: Diffusion	**Theory: 4 hrs**
Objectives	Contents
Define diffusion and list its importance in living systems. Define concentration gradient. List the factors affecting diffusion. Define facilitated diffusion and osmosis.	Definition of diffusion, concentration gradient and facilitated diffusion Factors affecting diffusion. Significance 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 .

4.2: Osmosis	**Theory: 3 hrs**
Objectives	Contents
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. List the significance of osmosis. Define active transport and give its significance.	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.
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 osmosis.
4.3: Transpiration	**Theory: 2 hrs**
Objectives	Contents
Define transpiration. Define stomatal, lenticular and cuticular transpiration. Describe factors affecting transpiration. Describe the significance of transpiration.	Definition of transpiration and its types. Factors affecting transpiration. Significance of transpiration.
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, diagrams and demonstration of transpiration.
4.4: Photosynthesis	**Theory: 3 hrs**
Objectives	Contents
Define Photosynthesis.	Definition of Photosynthesis.

List some major photosynthetic pigments and identify their role, structure of chloroplast. Identify the sites of photosynthesis. List the major steps of photosynthesis. List the factors affecting 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: 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 demonstration.
4.5: Respiration	**Theory: 4 hrs**
Objectives	Contents
Define respiration. Define and differentiate aerobic and anaerobic respiration. Identify the sites of respiration. List the major steps of aerobic respiration. List the factors affecting aerobic respiration. 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: 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 demonstration.
Unit 5: Taxonomy and Biodiversity	**Theory: 50 hrs**

5.1: Concept of Taxonomy	**Theory: 3 hrs**
Objectives:	Contents:
Define plant taxonomy. Give importance of plant taxonomy. Give scope of taxonomy and its importance to other branches of biology. Identify taxonomic hierarchy and categories in plant classification with examples. Define binomial system of nomenclature.	Definition, scope, interrelationship and importance of plant taxonomy Taxonomic hierarchy, categories and examples in plants classification Binomial nomenclature
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.
5.2: System of classification	**Theory: 2 hrs**
Objectives	Contents
Define artificial, natural and phylogenetic systems of classification with examples and their differences.	Artificial, natural and phylogenetic systems of classification Examples of artificial, natural and phylogenetic systems of classification
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark) and Short (3 marks).	**Teaching Methods or Material:** Classroom instruction, textbooks, reference books, charts, diagrams.

5.3: Concept of Biodiversity	**Theory: 6 hrs**
Objectives:	Contents:
Define biodiversity.	

Discuss importance of conserving biodiversity. Give levels of biodiversity- ecosystem and habitat diversity, species diversity and genetic diversity. List and define major types of ecosystems- terrestrial, aquatic, forest, grassland, desert, pond, marine, savannah, and tundra. List protected plant species in Nepal. Define endemic species and list the endemic tree species in Nepal.	Biodiversity, its levels and importance of its conservation Major types of ecosystems Protected plant species in Nepal Definition of endemic species and the list of endemic tree species in Nepal- *Homalium nepaulense, Prunus himalaica and Ormosia glauca*
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.
5.4: Virus	**Theory: 5 hrs**
Objectives	**Contents**
Define virus. Give general characteristics of virus. Give chemical composition of virus. Give classification of virus on the basis of host and genetic material. Give structure of a Bacteriophase. Summarize the process of viral replication. Describe the mode of transmission of virus. List some viral diseases in plants. Describe the economic importance of virus.	Definition, general characteristics, chemical composition, and classification of virus Structure of Bacteriophase Process of viral replication Mode of transmission of virus Common viral diseases in plants. 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.

5.5: Bacteria and Cyanobacteria	**Theory: 4 hrs**
Objectives	Contents
Define bacteria. Give general characteristics of bacteria. Give the cellular structure of bacteria. Give classification of bacteria based on shape, Gram staining and mode of nutrition. Describe the economic importance of bacteria. Define cyanobacteria. Give general characteristics of cyanobacteria. Give examples of cyanobacteria. Describe the economic importance of cyanobacteria.	Definition, general characteristics of fungi Structure of bacterial cell. Classification of bacteria on shape, Gram staining and nutrition basis Economic importance of bacteria Definition, characteristics and examples of cyanobacteria (structure of nostoc) Economic importance of cyanobacteria
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.
5.6: Fungi	**Theory: 5 hrs**
Objectives	Contents
Define fungi. Give general characteristics of fungi. Outline the classification of fungi. Describe life cycle of Yeast with labeled diagram. Describe the life cycle of *Puccinia* with labeled diagram. Describe economic importance of Fungi.	Definition, general characteristics and classification of fungi. Life cycle of Yeast. Life cycle of *Puccinia.* Economic importance of fungi.
Evaluation:	**Teaching Methods or Materials:**

Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	Classroom instruction, textbooks, reference books, charts and diagrams or demonstration. herbarium specimens of diseased plant parts and preserved fungal materials
5.7: Algae	**Theory: 4 hrs**
Objectives	Contents
Define Algae. List general characteristics of Algae. Give three major classes of Algae- Chlorophyceae, Phaeophyceae and Rhodophyceae with their chief distinguishing features. Describe structure, reproduction and life cycle of *Spirogyra* using labeled diagram. 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
5.8: Bryophyta	**Theory: 4 hrs**
Objectives	Contents
Define Bryophyta. Give general characteristics of Bryophyta. Classify Bryophytes as liverworts, hornworts and mosses. List economic importance of Bryophyta. 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:	**Teaching Methods or materials :**

Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	Classroom instruction, textbooks, reference books, charts and diagrams. fresh or preserved plant materials
5.9: Pteridophyta	**Theory: 3 hrs**
Objectives	Contents
Define Pteridophyta. Give general characteristics of Pteridophyta. Describe life cycle of fern with well-labeled diagram. 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
5.10: Gymnosperms	**Theory: 4 hrs**
Objectives	Contents
Define Gymnosperms. Give general characteristics of Gymnosperms. List major groups of living Gymnosperms with examples of representative species. Explain systematic position and general morphology of *Pinus.* Define mycorrhizal roots in *Pinus.* Discuss xerophytic anatomical features of *Pinus* needle. Give economic importance of Gymnosperms.	Definition and general characteristics of Gymnosperms. Major groups of living Gymnosperms and representative species of each group Systematic position and general morphology of Pinus Definition of mycorrhizal roots of *Pinus* Xerophytic features of *Pinus* needle Economic importance of Gymnosperms
Evaluation:	**Teaching Methods or Materials:**

Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	Classroom instruction, textbooks, reference books, charts and diagrams. fresh plants or preserved specimens
5.11: Introduction to Angiosperms	**Theory: 2hrs**
Objectives	Contents
Define Angiosperms. Give general characteristics of Angiosperms. 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 .12: Morphology of Angiosperms	**Theory: 6 hrs**
Objectives:	Contents:
Describe the angiospermic plants in semi technical terminologies. Habit; Root-(types, modifications); Stem-(types, modifications); Leaf-(types, attachment, arrangement, margin, apex, texture, venation, surface, shape, modification); Inflorescence-(definition, basic types and subtypes); Flower- (attachment, bract, symmetry, sex, position of ovary, arrangement of whorls; Calyx- adhesion, aestivation, duration; Corolla- adhesion, aestivation, shape; Perianth- adhesion, color, aestivation; Androecium- parts of stamen, adhesion, attachment, length, anther cells, attachment of filament, projection; Gynoecium- parts of carpel, adhesion, position of ovary, no of chambers, placentation, types	Description of angiospermic plants in semi technical terminologies. habit; general types, parts, features, modifications of root, stem, Leaf, inflorescence, flower

of stigma); Fruit- (definition, basic types and subtypes).	
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. fresh plants or preserved specimens
5.13: Study of some Angiosperm families	**Theory: 6 hrs**
Objectives	Contents
Discuss the characteristic features of some common Angiosperm families with examples and economic importance: Asteraceae, Poaceae, Cruciferae, Solanaceae, Fabaceae.	Description of characteristic features of some common Angiosperm families with habit, habitat, examples and economic importance of each: Asteraceae, Poaceae, Cruciferae, Solanaceae and Fabaceae.
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
Unit 6: Embryology of Angiosperms	**Theory: 10 hrs**
6.1: Reproduction	**Theory: 3 hrs**
Objectives	Contents
Define asexual reproduction Mention types of asexual reproduction in plant.	Definition of asexual reproduction. Types of asexual reproduction in plant.
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.

6.2: Pollination	**Theory: 3 hrs**
Objectives	Contents
Define pollination. Define self and cross-pollination. List different types of pollination based on pollinating agent and features of flowers with such pollinations. Discuss merits and demerits of self and cross-pollination. Discuss mechanisms developed by flowering plants for cross-pollination.	Definition of pollination Definition of self and cross-pollination Types of pollination based on pollinating agents Modification of flowers in favor of particular pollinating agent Merits and demerits of self and cross-pollination Mechanisms developed by flowering plants for cross-pollination
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.
6.3: Fertilization	**Theory: 4 hrs**
Objectives	Contents
Define fertilization. Describe the structure of a typical angiosperm ovule with diagram. Describe the process of pollen germination, pollen tube development, double fertilization and triple fusion in angiosperms.	Definition of fertilization. Structure of a typical angiosperm ovule with diagram Process of fertilization of in angiosperms Double fertilization and triple fusion
Evaluation: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams.

Unit 7: Genetics	**Theory: 5 hrs**
7.1 Heredity and Variation	**Theory: 2 hrs**
Objectives	Contents
Define heredity and variation. Explain causes of variation like environmental causes, mutation (gene and chromosomal), polyploidy etc. Define somatic and genetic variation, continuous and discontinuous variations. Describe the significance of variation. Define the terms: Chromosome, gene, alleles, genotype and phenotype, homozygous and heterozygous and clone.	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
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.
7.2 Mendel's Law of Inheritance	**Theory: 3 hrs**
Objectives	Contents
Explain Mendel's experiments. List the reasons for selecting pea plant by Mendel in his experiment. Define monohybrid and dihybrid crosses. 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.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, and diagrams, show pea plants and introduce its different parts.

Types of questions: Very short (1 mark), Short (3 marks) and Long (7 marks).	
Unit 8: Economic Botany	**Theory: 7 hrs**
8.1: Food Plants	**Theory: 2 hrs**
Objectives	Contents
List some important food plants of Nepal including cereals, pulses, vegetables and fruit plants . 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.
8.2: Medicinal Plant	**Theory: 2 hrs**
Objectives	Contents
List some important medicinal plants of Nepal.	Some important meditional plants of Nepal and their uses.
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.

8.3: Concept to Ethnobotany	**Theory: 3 hrs**
Objectives	Contents
Define the term ‘ethnobotany’.	Definition of ethnobotany.

Discuss the scope and value of ethnobotany. Discuss the value and importance of traditional knowledge.	Scope and importance of ethnobotany Value and importance of traditional knowledge
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.
Unit 9: Biotechnology	**Theory: 8 hrs**
9.1: Introduction to Biotechnology	**Theory: 3 hrs**
Objectives	Contents
Define Biotechnology. List the branches of Biotechnology. List the application of Biotechnology.	Definition, branches and applications of Biotechnology.
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.
9.2: Plant Tissue Culture	**Theory: 3 hrs**
Objectives	Contents
Define *in vitro* culture. Define cell, tissue, and organ culture. Define cellular totipotency. Define culture media. Tell importance of sterilization and list methods of sterilization. Define and summarize procedures of micropropagation and list its applications.	Definition of in *vitro* culture, cell, tissue and organ culture. Definition of cellular totipotency. Definition of culture media. Signification of sterilization and its techniques. Micropropagation and its applications. Application of Plant tissue culture.

List the applications of Plant Tissue Culture.	
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, diagrams and photographs. Equipments can also be shown.
9.3 Introduction to Plant Breeding	**Theory: 2 hrs**
Objectives	Contents
Define plant breeding. List and define the methods of plant breeding (Hybridization). Discuss the significance of plant breeding.	Definition, scope, significance and methods of plant breeding
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.

Botany Practical

Course: Botany Practical	**Hours: 64**

Practical 1: Molecular Biology	**Practical: 8 hrs**
Objectives Test presence of reducing sugars in the given sample using Benedict's solution. Test presence of starch in given sample using Iodine solution. Test presence of protein in given sample using Biuret method. 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.
Evaluation: viva voce, home assignment.	**Teaching Methods or Materials:** Lab instruction, practical activity, text books.
Practical 2: Plant Breeding	**Practical: 6hrs**
Objectives: Learn basic techniques and processes of hybridization experiments.	**Contents:** Visits to nearby agricultural centers to observe hybridization experiments.
Evaluation: Viva voce, and evaluation of mini-report, home assignment.	**Teaching Methods or Materials:** Field trip and briefing, reference books. Instruction on writing mini-report.
Practical 3: Biotechnology	**Practical: 6 hrs**
Objectives: List the equipments used in tissue culture. Describe basic technique and processes of tissue culture.	**Contents:** Visit nearby tissue culture laboratory to observe tissue culture in progress. List equipments used in tissue culture.
Evaluation: Viva voce, home assignment and evaluation of mini-report.	**Teaching Methods or Materials:** Field trip and briefing, reference books.

	Instruction on writing mini-report
Practical 4: Plant Anatomy	**Practical: 6 hrs**
Objectives: Describe the structure and functioning of a compound microscope. Prepare temporary slides of dicot and monocot stems to study the anatomical structures. Prepare temporary slides of dorsiventral and isobilateral leaves to study the anatomical structures. Describe annual rings in dicot stem.	**Contents:** Structure and functioning of a compound microscope Preparation of temporary slides of dicot and monocot stems to study their anatomy Preparation of temporary slides of dorsiventral and isobilateral leaves to study the anatomical structures Study of annual rings in sliced wooden logs of a dicot plant
Evaluation: Viva voce, home assignment, evaluation of slides.	**Teaching Methods or Materials:** Labinstruction, texbooks, charts, use of microscope, show slices of wooden logs.
Practical 5: Physiology	**Practical: 12 hrs**
Objectives Study diffusion using copper sulphate crystals put in a beaker of water. Study osmosis through egg membrane. Study the rate of transpiration under different environmental conditions using Ganong's potometer. Demonstrate experimentally that oxygen is evolved during photosynthesis. OR Demonstrate experimentally that carbon dioxide is necessary for photosynthesis. Demonstrate that carbon dioxide is evolved during aerobic respiration.	**Contents** Study of diffusion using copper sulphate crystals put in a beaker of water Study of osmosis through egg membrane Study of the rate of transpiration under different environmental conditions using Ganong's potometer Demonstration of evolution of oxygen during photosynthesis. OR Demonstration of requirement of carbon dioxide during photosynthesis Demonstration of evolution of carbon dioxide during aerobic respiration

Demonstrate that carbon dioxide is evolved during fermentation.	Demonstration of evolution of carbon dioxide during fermentation
Evaluation: Viva voce, home assignment, evaluation of lab procedures.	**Teaching Methods or Materials:** Lab instruction, textbooks, charts, use of instruments and equipments.
Practical 6: Taxonomy and Biodiversity	**Practical: 22 hrs**
Objectives **Monera:** Study the different types of bacteria based on their morphology using permanent slides. Study the filaments of *Nostoc* using compound microscope. **Fungi:** Study yeast cells and their budding under compound microscope. Study different stages in the life cycle of *Puccinia* using permanent slides **Plantae:** Study structure and conjugation in *Spirogyra* using compound microscope. Study vegetative structure and stages of reproduction in *Marchantia* using fresh materials, preserved specimens and permanent slides. Study the vegetative structure and reproductive stages of fern including herbarium specimen of sporophyte, slide of v. s. of leaf through sorus, and prothallus. Study of the male and female cone of *Pinus.*	**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 different stages of life cycle of *Puccinia* using permanent slides 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*

Study the morphology and T. S. of *Pinus* needle. **Taxonomy of Angiosperms:** Study different types of modification of root, stem and leaf. Describe the representative plants of angiospermic families in semi-technical terms (Brassicaceae, Solanaceae, Fabaceae, Asteraceae and Poaceae).	Study of morphology and anatomy of *Pinus* needle **Taxonomy of Angiosperms:** Study of some modifications of root, stem and leaf Describe the some angiosperm families in semi-technical terms (Brassicaceae, Solanaceae, Fabaceae, Asteraceae and Poaceae)
Evaluation: Viva voce, home assignment, evaluation of lab activity.	**Teaching Methods or Materials:** Dissecting and compound microscopes, permanent slides, textbooks, lab instructions, charts, fresh or preserved specimens, permanent slides.
Practical 7: Embryology of Angiosperms	**Practical: 4 hrs**
Objectives Study the permanent slide of angiosperm ovule. Study permanent slide of a dicot embryo.	**Contents** Study of angiosperm ovule using permanent slide Study of dicot embryo using permanent slide
Evaluation: Viva voce, home assignment, evaluation of lab activity.	**Teaching Methods or Materials:** Compound microscope, permanent slides, charts, textbooks, lab instructions, permanent slides.

Zoology

Credit hours: 4+1 hrs/week **Full Marks: 100**

Total hours: 192

Theory 128

Practical: 64

Course Description

This basic course in zoology discusses the characteristics of unicellular and multicellular structures .The course contains introductory zoology, cell biology, animal diversity, ,evolution of organisms 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, frog and squirrel so as to expose different systems.

- Tell the meaning, scope and different branches of zoology.
- Explain structure and function of different kinds of tissues in a body.
- Identify diversified forms of animal life
- Explain different systems of mammals.
- Describe how organisms of today have been evolved from the ancestral ones
- Describe the relationships of organism with their surrounding.
- Handle microscope properly
- Identify different kinds of animals
- Prepare temporary slide mount of the given specimen.
- Dissect the mammal so as to expose its different systems.

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

Practical Zoology (Chordate) - P. S. Verma

Reference Books:

A Textbook of Zoology - Vidyarthi R. D. and Pandey P. N.

Modern Approach to Zoology - T. C. Majupuria

Ecology and Ethology - V. K. Agrawal and V. Gupta

Course: Zoology	**Theo.128 HRS** **Practical -64 Hrs**
Unit: 1 introduction to zoology	**Hrs. 2 theory**
1.1 definition, scope and branches of Zoology	**Hrs. 2 theory**
Objectives	*Contents*
State the meaning of zoology Describe the branches and fields of biology and their scopes.	Meaning of zoology, Scope of zoology, different branches of zoology: Morphology, anatomy, physiology, cytology, embryology, physiology, parasitology entomology, Helminthology, proto-zoology, Bacterology, virology, paleontology, ecology, genetics, toxicology
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion textbook, and reference book self study.
Unit: 2 Cell biology	**Hrs. 17 theory**
2.1 Introduction to cell	**Hrs. 5 theory**
Objectives	Contents
Explain that cell is a basic unit of life, Differentiate between plant cell and animal cell . Differentiate between prokaryotic and eukaryotic cell. State the meaning of cyclosis, exocytosis and endocytosis	Ultra structure of different cell organelles and their functions: Cytoplasmic contents: cellmembrane mitochondria, endoplasmic reticulum, glogi complex, lysosome , centrosome, vacuoles, cilia and flagella Nucleoplasmic contents: chromosomes, nucleolus, nuclear membrane Difference between cytoplasm and nucleoplasm Meaning of cyclosis, exocytosis and endocytosis.

Evaluation methods: oral and written tests, home assignments.	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
2.2 Cell division	**Hrs. 12 theory**
Objectives	*Contents*
Define cell cycle, amitosis, mitosis and meiosis. Describe amitosis cell division. Explain the significance of amitosis cell division. Describe the steps of mitotic cell division using a labeled diagram. Explain the significance of mitosis. Describe the steps of meiotic cell division with necessary sketches. Explain why meiosis is called reductional division and is important in sexually reproducing organisms. Explain the significance of meiosis. 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:3 Cell biology, Tissues and their types	**Hrs. 5 theory**
3.1 Tissues and their types	**Hrs. 5 theory**
Objectives	*Contents*
Define tissue. Name different types of tissues (epithelial tissues, connective tissues, muscular tissues, nervous tissues). Describe structure, function and location of these tissues in human body.	Definition of tissue and its types. Functions of epithelial tissues i.e protection, secretion, excretion, absorption and exchange of different materials

Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
Unit: 4 Diversity of animal life	**Hrs. 6 theory**
4.1 concept of taxonomy	**Hrs. 2 theory**
Objectives	*Contents*
Define taxonomy Define species as a basic unit of classification. Distinguish between artificial and natural classification Identify features studied in natural electrification. List modern criteria for classification of animals Define the terms used in classification.	Definition of taxonomy, species as a basic unit of classification, systematics, taxon, lower and higher taxa Different systems of classification Differences between artificial and natural systems of classification
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources**: classroom instruction, discussion, textbook/ reference books self study.
4.2 Binomial nomenclature and classification.	**Hrs. 4 theory**
Objectives	*Contents*
Define binomial nomenclatures. Identify the importance of nomenclature. Identify the system adopted by the International Code of Zoological Nomenclature. Write scientific names of commonly found animals. Describe each of the five kingdoms of classification with examples.	Binomial system of nomenclature adopted by Carolus Linnaeus (1707-1778). Selected examples of binomial nomenclature of animals. Five kingdom system of classification. Chief characteristics and examples of five kingdoms.
Evaluation methods: Oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.

Unit : 5 Animal phylogeny and classification	**Hrs.12 theory**
5.1 General characteristics and classification of different phyla of animals.	**Hrs. 12 theory**
Objectives	*Contents*
List the general characters of the phyla(Protozoa, Porifera, Coelentereta, Platyhelminthes, Aschelminthes, Annelida ,Arthropoda, Mollusca ,Echinodermata and Chordata). Give the classes of every phylum and two examples of each.	General charecters of phylum Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Chordara.
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book, self study.
Unit: 6 Basic concept of origin and evolution of life.	**Hrs. 8 theory**
Objectives	*Contents*
Define evolution and organic evolution. Describe historical background of organic evolution. Give examples of organic evolution. Describe the evidences of organic evolution: morphological and anatomical palaeontolgical, biochemical, genetic and embryological. Describe the Lamark's theory of evolution giving examples cited by him. Describe the Darwin's theory of evolution with examples. Identify drawbacks of Darwin's theory of evolution. Identify drawbacks of Darwin's theory. Describe the origin and evolution of man Describe modern synthesis theory of evolution.	Evolutionary history of organisms. Evidences of organic evolution. Different theories of organic evolution.
Evaluation methods: oral test, home assignments, written examination.	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
Unit 7: Study of Earthworm	**Hrs. 6 theory**

Objectives	*Contents*
Give the systematic position, habit and habitat of earthworm. Describe the morphology of earthworm with sketch. Define digestion and describe the digestive system of earthworm. List the organs involved in the digestive system. Describe the physiology of digestion in earthworm. Define the reproduction and describe the reproductive systems of earthworm. Describe the male reproductive organs and female reproductive organs of earthworm. Describe the nervous system of earthworm. Give the economic value of earthworm.	Systematic position, habit, habitat, external, features, digestive system, reproductive system, and nervous system -Economic importance of earthworm.
Evaluation methods: oral test, home assignments, written examination.	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
Unit: 8 Study of some economically important insects.	**Hrs. 8 theory**
Objectives	*Contents*
Give the systematic position, habit, habitat, life cycle of Honey bee and Silk worm. Describe the morphology of Honey bee and Silk worm with sketch. Morphology & life cycle of liverfluck & tapeworm Economic importance of Honey bee, Silk worm Characters of silk thread.	Systemic position, habit and habitat, life cycle, structure, and economic importance of Honeybee and Silkworm. Morphology & life cycle of liverfluke & tapeworm.

Evaluation methods: oral test, home assignments, written examination.	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
Unit 9: Study of life process of mammals	**Hrs. 28 theory**
Objectives	*Contents*
Give the systematic position and morphology of man with sketch. Describe the digestive system, respiratory system, circulatory system, reproductive system, excretory system of man, Endicrine system & sensse organs-eye, ear.	Systemic position and morphology of man. Digestive system, Endocrine glands. Respiratory system, Sense organ-eye, ear Circulatory system. Reproductive system Excretory system and Nervous system
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study
Unit 10: Ecology and environment	**Hrs. 22 theory**
10.1 Ecosystem	**Hrs. 8 theory**
Objectives	*Contents*
Define ecosystem and its types. Identify major types of ecosystem- aquatic and terrestrial ecosystems List abiotic and biotic factors of different ecosystems. Identify the interacting system of biotic factors: Positive interactions-commensalism, mutalism, colonization, and social organization Negetive interactions- predation, parasitism, competition and antibiosis. Define food chain and trophic level. Develop a diagrammatic representation of food chain. Describe energy and energy relations in an 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.

Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
10.2 Bio-geochemical cycles	**Hrs. 6 theory**
Objectives	*Contents*
Define Biogeochemical cycle. Describe the Carbon cycle, Water cycle Oxygen cycle and Nitrogen cycle.	Sources of carbon, oxygen, water 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.
10.3 Ecological imbalances and consequences	**Hrs. 4 theory**
Objectives	*Contents*
Explain the theory of the greenhouse effect. List the cause of green house effect. Write the consequences of the green house effect. Discuss the significance of green house effect, and explain why many scientists believe it will create a global crisis. Define the acid rain and its effects. State the importance of the ozone layer for living organisms. Describe how some scientists' believe the ozone layer is going to deplete. Describe the consequences of the depletion of the ozone layer.	Description of greenhouse effect, acid rain and depletion of the ozone layer. Description of global warming & its effects.
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbooks, and reference books self study.

Sub unit: 10.4 Environmental pollution	**Hrs. 4 theory**
Objectives	*Contents*
Define pollution. List biodegradable pollutants. List nonbiodegradable pollutants. List the sources of water pollutants. Identify the causes of water pollution. List the effects of water pollution List the preventive measures to control the water pollution. List the source of air pollution. List the effects of air pollution Mention the preventive measures to control air pollution. List the source of soil pollution. List the effects of soil pollution. 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 :11 Animal adaptation	**Hrs.4 theory**
Objectives	*Content*
Define adaptation. Define the aquatic adaptation with examples. Define the terrestrial adaptation. List the different types of terrestrial adaptations along with examples.	Meaning of adaptations Explanation of the adaptational features and examples of aquatic adaptation Explanation of the adaptational features of terrestrial adaptation and its types along with examples

Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbook, and reference book self study.
Unit : 12. Animal behavior	**Hrs. 4 theory**
Objectives	*Contents*
Define the reflex action. Define the taxes and their types. Explain leadership and qualities of a leader. List some common examples of leadership in animals.	Definition of learned behavior and inborn behavior Definition of reflex action Definition of taxis and its types Definition of Leadership and the qualities of leader
Evaluation methods: oral test, home assignments, written examination	**Teaching learning activities and resources:** classroom instruction, discussion, textbooks, and reference books self study.
Unit: 13. Conservation of wildlife	**Hrs. 6 theory**
Objectives	*Contents*
Define wildlife. Define the endangered species. List the endangered species of Nepal and causes of extinction. Define the rare and threatened animals with examples. List the methods to conserve the wild life. Give the methods to conserve the forest. Explain the importance of afforestation. 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 Practical

Course: Practical Zoology	**Hrs .lab 64**
Unit 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.
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Course: Practical Zoology **Unit 2:General study of the animal kingdom**	**Hrs. 10 lab**
Objectives	*Contents*
Study the given slides, specimens Draw diagramestic of given specimens Write down the characters of given specimens slides classify the specimens properly.	Study of permanent slides: protozoa: *Amoeba, Paramecium* Study of museum specimens: Porifera-*Sycon* Coelenterata-*Hydra* Platyhelminthes-Tapeworm, liver fluke Aschelminthes-*Ascaris* Annelida-Earthworm and leech Arthropoda- Butterfly, Crab, Scorpion, Spider, Centipede, Prawn Mollusca –*Pila* Echinodermata-Starfish Phylum:Chordata Class: Pisces – *Labeo,Exocoetus*

	Class: Amphibia-Frog,Toad Class:Reptilia-wall lizard. Class:Aves-Pigeon, Parrot. Class: Mammals-Squirrel, Bat.
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Course: Practical Zoology **Unit 3: Study of animal tissues**	**Hrs. 4 lab**
Objectives	*Contents*
Study the types of animals tissue Give comments upon the given tissues.	Squamous, columnar, cuboidal, adipose, areolar, hyaline, cartilage, t.s of bone and blood of man.
. Evaluation methods: practical performance, test, viva	Teaching learning activities and resources: classroom instruction, demonstration
Course: Practical Zoology **Unit 4: Study of histological slides of mammal.**	**Hrs. 4 lab**
Objectives	*Contents*
Study of the structure of the histology of different parts of the body	V.S of skin, T.S of oesophagus T.S of duodenum, T.S of liver. T-S of pancreas, T.S of spleen, T.S lung, T.S of kidney T.S of testis T.S of ovary
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Course: Practical Zoology	

Unit 5: Preparation of temporary slides and their study	**Hrs. 4 lab**
Objectives	*Contents*
Prepare the temporary slide. Study the prepared slide Draw the well labeled diagram provide comments on the diagrams.	Striated muscle (thigh of frog) Setae of earthworm
Evaluation methods : practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Course: Practical zoology **Unit 6: Dissection of animal**	**Hrs. 6 lab**
6.1 Dissection of earthworm	
Objectives	*Contents*
Dissect the earthworm to observe the general anatomy, alimentary canal, reproductive system and the brain (nervous system) of earthworm. 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 and nervous system
Evaluation methods : practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration
Course: Zoology **Unit 6: Dissection of animal**	**Hrs. 8 lab**
6.2 Dissection of frog	
Objectives	*Content*
Dissect the frog to expose the general anatomy, alimentary canal, reproductive system, and circulatory system, draw the well-labeled diagrams of the given systems and comment on them.	Instruments used for dissection. Exposure of general anatomy, alimentary canal, arterial system, venous system, male reproductive system and female reproductive system.

Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Course: Practical Zoology **Unit: 6 Dissection of animal**	
6.3 Dissection of Rat	**Hrs.8 lab**
Objectives	*Contents*
Dissect and observe the general anatomy alimentary canal and associated glands, circulatory, system, reproductive system, brain of mammal. Draw the well- labeled diagram.	Instruments for dissection. Exposure of general anatomy, alimentary canal, arterial, system, venous system, male and female reproductive system and brain.
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration.
Course : Practical Zoology **Unit 7: Study of an ecosystem**	**Hrs. 4 lab**
7.1 Pond ecosystem	
Objectives	*Contents*
Define ecosystem Name/List/Give the abiotic and biotic factors of an ecosystem Define aquarium -Draw the well labeled diagram to show the food chain in ecosystem.	Abiotic factors of a pond. Biotic factors of pond. Aquarium as a pond ecosystem.
Evaluation methods: practical performance, test, viva class activities.	**Teaching learning activities and resources:** classroom instruction, demonstration, visit to field-pond, rivers, forest.
Course: Practical Zoology **Unit: 7 Study of an Ecosystem**	**Hrs. 8 lab**
7.2 Grassland ecosystem	

Objectives	*Contents*
Define ecosystem. Define grassland ecosystem. Tell the abiotic and biotic, factors. Draw a diagram to show the food chain in grassland ecosystem.	Abiotic factors of a grassland Food chain of grassland ecosystem
Evaluation methods: practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration, visit to field – grassland, forest etc.

Second Year

Extension and Community Development

Agribusiness Management and Cooperative

Aquaculture and Fisheries

Statistics and Computer Application

Introductory Animal Husbandry

Principles and Practices of Agronomy

Plant Protection

Soil Management, Conservation and Environmental Science

Post Harvest Technology

Extension and Community Development

Credit hours: (3+1) hrs/week **Full Marks: 100**

Total hours: 160

Theory: 96 hrs

Practical: 64 hrs

Course Description

This course provides the basic knowledge and skills in education and extension education for community development program to the students. These courses include education and extension education, their principle and philosophy, origin, and historical development of Agricultural extension in Nepal. The extension teaching method used in transfer of technology in innovation diffusion their planning, monitoring and evaluation process. This course also studies sociological concept and importance in community development, group formation and dynamic on social process, motivation, gender development, leadership development, social mobilization and need based training and their importance in agriculture development.

Course Objectives

This Course has the following Objectives:

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

- Define the education and extension education
- Explain principle, philosophy, teaching and learning in agricultural extension.
- Apply the knowledge of extension education in TOT, program planning, monitoring and evaluation of agricultural extension programs.
- State sociological concept and terms with group dynamics, leadership, social mobilization.
- Explain gender and development, type and methods used in need based training to motivate the people in rural development programs.
- Develop the knowledge and skills in identifying social problems, data gathering technique, analysis and presentation.
- Visit different district level line agencies and understand their program, strategy and organizational structure.
- Communicates effectively with individuals and group in variety of setting by using different means of communication.

Minimum Standards

Students must secure a minimum of 40 percent marks in theory and 60 percent marks in practical examination.

Text and Reference books:

1. Ban, A.W., Van Den and H.S. Hawkins. 1998.Agricultural Extension. S.K.Jain for CBS Publishers and Distributors, new Delhi.

2. Bhatnagar, O.P. and O.P. Dahama. 1998. Extension and Communication for Development. Oxford and IBH Publishing Co., Ltd. New Delhi.

3. Bhusan, V. and D.R. Sachdeva. 1994. An Introduction to Sociology. Kitab Mahal, Allahabad.

4. Chitambar, J,V. 1973. Introductory Rural Sociology. Wiley Eastern Ltd., India.
5. Dongol, B. B. S. 2004. Extension Education. Pratima Singh Dongol, Kathmandu, Nepal.
6. Khan, S.S. and J.S. Sah. 2001. Social Mobilization Manual based on Syanja Experience, Social Mobilization Experimentation and Learning Center, UNDP/IAAS.

7. Mathialagan, P. 2007. A text Book of Animal Husbandry & Livestock Extension. International Book Distributing Co.Lucknow, India.
8. Nakkiran S and G. Ramesh. 2010. Research Method in Rural Development. Deep and Deep Publication Pvt. Ltd.New Delhi.
9. Sandhu, A. A. 1993. A Text Book of Communication Process and Method. Raju Primlani for Oxford & IBH Publishing Company Pvt. Ltd. New Delhi, India.
10. Shankar Roa, C. N. 2011. Sociology. Principle of Sociology with an Introduction to Social thought. S. Chand & Company Ltd,New Deldi, India.
11. UNDP. 2001. Governance and Poverty Reduction: National Human Development Report, Kathmandu.
12. SSMP. 2004. Krishi Prashar ka Tarikaharu (training manual in Nepali) . Sustainable Soil Management Program. Balkhutole, Lalitpur, Kathmandu.

Course:	**Hrs. Theory : Hrs. Practical :**
Unit: 01. Introduction	**Hrs theory :03**
Objectives	Contents
Explain education, its type, role and importance in RD.	Meaning, concept and definition of education and its type, role and importance of education in rural development
Evaluation Methods: Assignment presentation and written exam.	**Teaching /Learning activities and resources:** Class room instruction (lecture), group discussion and assignment presentation.
Unit: 02. Extension Education System in Nepal.	**Hrs theory :10**
Objectives	Contents

Extension and community development Practical

• Define extension education. • Explain the history scope, objective and importance of extension education in rural development. • Describe organizational setup, Extension system and approaches used in Nepal.	Meaning, concept, origin and history of extension education. Objective, area and scope of extension education. Need and importance of extension education. Historical development of agricultural extension in Nepal. Organizational structure of Ministry of Agriculture and co-operatives. Agricultural Extension system and approaches used in Nepal. Present extension system used in Nepal
Evaluation Methods: Oral and written test.	**Teaching /Learning activities and resources:** Class room instruction and class discussion.
Unit: 03. Teaching and learning process.	**Hrs Theory 12**
Objectives	Contents
• State teaching and learning process, their elements and steps in effective teaching learning process. • Explain extension teaching method, communication and audio-visual aids used in agricultural development.	Meaning and concept of teaching learning. Elements and steps of teaching learning process. Principles and law of learning. Factor affecting adult learning Extension teaching method Individual method / contact Group method / contact Mass method / Contact Audio-visual aids – Meaning, concept, nature and classification

	Meaning, concept and definition of communication and their elements, function and role in agriculture development.
Evaluation Methods: Oral and written test.	**Teaching /Learning activities and resources:** Class room instruction (lecture), class discussion and visual (chart) presentation.
Unit:04. Transfer of technology.	**Hrs theory :04**
Objectives	Contents
Explain adoption diffusion process. Describe the factors, process and characteristics of innovation decision.	Meaning and concept of adoption, diffusion and innovation Adoption process, adopters category and adopters characteristics. Factor affecting adoption of innovation in decision making process.
Evaluation Methods: Written test exam.	**Teaching /Learning activities and resources:** Class room instruction, class discussion.
Unit: 05. Program planning, monitoring and evaluation in extension	**Hrs theory :06**
Objectives	Contents
• Define program, planning and program planning. • State the principles, type of program planning. • Explain the steps of monitoring and evaluation of extension programs	Meaning, concept and importance of program, planning and program planning. Principle of program planning. Type of program planning. Steps in program planning. Meaning and concept of monitoring and evaluation of extension program Basic steps in evaluating extension program

Evaluation Methods: Oral and written exam.	**Teaching /Learning activities and resources:** Class room instruction, class discussion.
Unit: 06. Basic sociological concept	**Hrs Theory 12**
Objectives	Contents
• Define sociology and rural sociology • Explain the importance of rural sociology and sociological concept and terminology.	Meaning, concept and definition of sociology and rural sociology. Importance of rural sociology in agricultural extension. Sociological concept and terminology: society, culture, Social process, Community, Association, Organization, Institution – Family, Marriage, Religion, Social norms, value, belief, custom, Caste and ethnicity, Role, status, position, power and prestige, Social group, social structure, socialization, social stratification .
Evaluation Methods: Oral and written exam.	**Teaching /Learning activities and resources:** Class room instruction (lecture), class discussion.
Course:	**Hrs. Theory : Hrs. Practical :**
Unit:07. Social mobilization and community development.	**Hrs theory :12**
Objectives	Contents
Explain the term social mobilization, it's history, experience and strategy. Identify the scope, role in different GOs and NGOs on community development.	Meaning, concept and purpose of social mobilization. History of social mobilization in Nepal. Lesson learned from the past experience from social mobilization. Local governance, decentralization for development strategy. Current strategy of decentralization in Nepal.

	Scope, role of Local agencies, community based Organization and NGOs in social mobilization. Principle of community development. Concept of sustainability development.
Evaluation Methods: Written test exam.	**Teaching /Learning activities and resources:** Class room instruction and group discussion.
Unit: 08. Group formation and group dynamics	**Hrs theory :12**
Objectives	Contents
• Explain the concept of group, their typology, importance and group formation procedure. • Explain co-operation, conflict, situation for conflict, intensity and conflict management or resolution technique.	Meaning, concept, type and importance of group, group formation procedure, group dynamics, group technique. Meaning, concept, type and role of co-operation. Meaning, concept, definition of conflict. Transition of conflict thought, situation for conflict, conflict intensity continuum (Measurement of conflict) and conflict resolution technique or management.
Evaluation Methods: Written exam.	**Teaching /Learning activities and resources:** Class lecture and group discussion.
Unit: 09. Rural leadership development.	**Hrs Theory 06**
Objectives	Contents
• Define the concept of leader and leadership. • Explain the role and characteristics of leader. • Discuss the selection, development and effectiveness of local leader.	Meaning, concept, type of leader and leadership. Basic elements and importance of leadership in extension. Qualities/characteristics, role leader in community development. Selection and development of local leader.

	Method of identify the local leader and leader effectiveness.
Evaluation Methods: Written exam test.	**Teaching /Learning activities and resources:** Class lecture and group discussion.
Unit: 10. Gender and development.	**Hrs theory :06**
Objectives	**Contents**
Explain the word gender and its origin. Describe WID, WAD and GAD Discuss gender issue in the context of Nepal. Explain the role of women farmers, gender need and gender analysis tools.	Meaning and concept of Gender. Origin of Gender and development. Concept of WID, WAD and GAD. Gender issue in the context of Nepal. Role of women farmers and gender issues in agriculture. Gender needs and its role. Concept of gender analysis tools.
Evaluation Methods: Written exam.	**Teaching /Learning activities and resources:** Class lecture, group discussion, brain storming.
Unit: 11. Need based training	**Hrs theory :04**
Objectives	**Contents**
• Explain the concept and importance of need based training. • Describe type of training. • Explain method, development and management of training program	Concept and definition of training. Need for farmer's training. Process of training. Type of training. Method of identifying the training needs. Development and management of training program.
Evaluation Methods:	**Teaching /Learning activities and resources:**

Written exam**.**	Class lecture, group discussion.
Unit: 12. Motivation	**Hrs Theory : 03**
Objectives	**Contents**
• Explain the concept of motivation and its purpose and process of motivation. • Identify the factor affecting motivation. • Describe the technique of motivation in developmental work,	Meaning, concept and definition of motivation. Purpose and process of motivation. Factor affecting motivation. Technique of motivation in community development program.
Evaluation Methods: Written exam and question answer.	**Teaching /Learning activities and resources:** Class lecture, group discussion.

Extension and community development Practical	**Hrs Practical : 30**
Practical 1: Visit farming community	**Hrs : one day (about 4-6 hour)**
Objectives	Contents
Observe the farming community. Identify and prioritize farmer's problems.	Identification and prioritization of farmer's problems.
Practical 2: Introduction to research and social survey	**Hrs :2:00**
Objectives	Contents
Identify the different researchable problems. Plan and implement the research process and surveying.	Research: Meaning, concept, definition and type of research.
Practical 3: Social sampling.	**Hrs :2:00**
Objectives	Contents
Identify sampling method and techniques used in social survey.	Meaning, concept and type or method or techniques of social sampling.

Practical 4: Questionnaire development	**Hrs :2:00**
Objectives	Contents
• Develop the knowledge and skill for questionnaire development for survey.	Meaning, concept, type and method of questionnaire development for surveying.
Practical 5: An introduction to data collection.	**Hrs :2:00**
Objectives	Contents
• Develop the knowledge and skills of data collection techniques.	Type of data, method of data collection.
Practical 6: PRA and RRA method and technique used in collection of information.	**Hrs :2:00**
Objectives	Contents
Develop the knowledge and skill for information gathering from PRA, RRA.	PRA and RRA technique
Practical 7: Data analysis	**Hrs :2:00**
Objectives	Contents
• Develop the skill of data analysis.	Different method used in data analysis.
Practical 8: Report writing and presentation	**Hrs :2:00**
Objectives	Contents
• Develop the knowledge and skills in report writing and presentation.	Format of writing the report for presentation.
Practical 9: Preparation of poster, chart and flash cards.	**Hrs :2:00**
Objectives	Contents
• Develop the skill of preparation poster, chart and flash cards.	Meaning, concept and technique of preparation of different type of visual aids.
Practical 10: Preparation of pamphlet, leaflet and booklet.	**Hrs :2:00**

Objectives	Contents
• Develop the skill of preparation on pamphlet, leaflet and booklet.	Meaning, concept and technique of preparation pamphlet, leaflet and booklet and their uses.
Practical 11: Conduct method demonstration	**Hrs :2:00**
Objectives	Contents
• Develop the knowledge and skill for conducting method demonstration.	Meaning, concept of method demonstration. Precaution used in method demonstration.
Practical 12: Visit and conduct result demonstration and farmer's field trial.	**Hrs :2:00**
Objectives	Contents
• Develop the knowledge and skill for result demonstration. • Observe farmer's field trial (FFT).	Meaning, concept of result demonstration. Precaution used in method demonstration.
Practical 13: Visit District level Agriculture / Veterinary office and Vet. hospital.	**Hrs :4:00**
Objectives	Contents
Visit district level program, planning and implementation mechanism.	Program, planning, strategy and group formation process.
Practical 14: Preparation of individual level farm production plan for farm family.	**Hrs :2:00**
Objectives	Contents
• Develop the skill for preparation of individual level farm production plan.	Steps used in farm production plan. Precaution of farm production plan building.
Practical 15: Preparation of training program	**Hrs :2:00**
Objectives	Contents
• Develop the knowledge and skills in preparation of training program.	Need of training, Type of training. Precaution of implementation training program.

Agribusiness Management and Cooperative

Credit hours: (3+1) **Full Marks: 100**

Total Hours: 160

Theory: 96 hours

Practical: 64 hours

Course Description

Farm Management, Agribusiness Management and Cooperative course is divided into three sections. They are:

Farm Management

Farm Management section covered introduction to Farm Management; importance of farm management and problems related to management of firms in Nepal; production relationship; principles involved in farm management decisions; farm planning; farm budgeting; farm inventory and records keeping; and farm efficiency measures.

Agribusiness Management

Agribusiness Management section covered the concept, definition and scope of agribusiness management; basic concept firms, plant, industry and their interrelationships of agricultural commodities; agribusiness environment and management systems; human resource, Organization and business management functions; preparation of financial statements, analysis and agribusiness financing; and investment appraisals; value chain analysis: concept, mapping and approaches; Production planning in agribusiness; national and International trade in High Value Crops (HVCs); and agricultural policies in agribusiness enterprises

Cooperative

Under cooperative section, the concept of cooperatives, cooperative operation in commercial farming and role of cooperative in agricultural commercialization are major areas for group's approach in agriculture commercialization.

Course Objectives

This Course has the following Objectives:

To acquaint the students with the principles of farm management for taking the decision in agricultural production;

To familiar with value chain development of agricultural commodities for commercialization; and

To explain the role cooperative in different stages value chain development such as production, processing, distribution and consumption of agricultural commodities for sustainable agriculture commercialization.

Minimum Standards

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

Text and Reference books

Panda, S. C. (2007). Farm Management and Agricultural Marketing. Kalyani Publishers, New Delhi

Manson, J. (1996). Farm Management. Kangaroo Press, Pennsylvania State University.

Kay, R.D. and Edwards, W. M. (1994). Farm Management. McGraw Hill, Inc., New Delhi.

Kahlon, A. S. and Singh, K. (1992). Economics of Farm Management in India. Allied Publishers, New Delhi.

Shankhyan, P. L. (1983). Introduction to Farm Management, Tata, McGraw-Hill, Co. Ltd., New Delhi.

Johl, S. S. and Kapoor, T. R. (1973). Fundamentals of Farm Business Management. Kalyani Publishers, New Delhi.

URL: http://www.acsbookshop.com/products/1657-farm-management.aspx

Downey, W. D. and Erickson, S. P. (1987). Agribusiness management. McGraw Hill Inc.

Rhodes, V. J. (1983). The agricultural marketing systems. John, Wiley, and sons, Inc. Singapore.

Gittinger, J. P. (1982). Economic Analysis of Agricultural Projects. 2nd eds completely revised and expanded. The John Hopkins University Press. London.

Fae, A. N. (1981). Crop Management Economics. Granada publishing. London.

Courses:	**Hrs. Theory: 96 Hrs. Practical : 64**
A. Farm Management	
Unit 1: Introduction to Farm Management	**Hrs Theory 3**
Objectives	**Contents**
Familiar with farm and farm management, nature and scope of farm management in agriculture. Develop the efficient utilization of farm resources for output maximization.	Definition, nature and scope Management of farm resources 1.2.1 Land Management 1.2.2 Farm Layout 1.2.3 Soil and nutrient management 1.2.4 Mechanization
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 2: Importance of farm management and problems related to management of firms in Nepal	**Hrs theory 2**
Objectives	**Contents**
Understanding of farm management in farming system. Familiar with problems of farm Nepalese context	2.1 Importance of farm management 2.2 Problems related to management of firms in Nepal
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 3: Production relationship	**Hrs Theory 10**
Objectives	**Contents**
Explain the factor- product relationship such as production functions and law of return;	Factor- product: production function, law return Factor –factor: isoquent, iso-cost line, least cost

Familiar with input- input relationship such as isoquant, iso- cost line and least cost combination; and Understand the product- product relationship such as joint, complementary, supplementary, competitive products and opportunity cost.	combination 3.1 Product- product: joint, complementary, supplementary and competitive products and opportunity cost
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 4: Principles involved in farm management decisions	**Hrs Theory 10**
Objectives	**Contents**
Explaining the principle of diminishing return, cost principles and substitution effects; Enable the combining the enterprises and equilibrium return; and Familiar with the comparative advantage and time comparison for taking the decision for production of agricultural commodities.	Principle of diminishing return Cost principle Principle of substitution Principle of combining enterprises Principle of equilibrium return Principle of comparative advantage Principle of time comparison
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 5: Farm planning	**Hrs Theory 3**
Objectives	**Contents**
Understanding the principles and characteristics farm planning. Familiar with farm planning techniques	Principles and characteristics of farm planning Techniques of farm planning
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Unit 6: Farm budgeting	**Hrs Theory 5**
Objectives	**Contents**
Familiar with enterprise, partial and complete budgeting. Develop the knowledge of farm planning and budgeting.	Enterprise Budgeting Partial Budgeting Complete budgeting Steps in farm planning and budgeting
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 7: Farm inventory and records keeping	**Hrs Theory 7**
Objectives	**Contents**
Develop the skills farm records keeping; Familiar with the calculation of depreciation; of farm machinery; and Develop the knowledge of preparing balance sheet, income statement and cash flow statement.	7.1 Farm records keeping 7.2 Calculation depreciation 7.3 Balance sheet 7.4 Income statement 7.5 Cash flow statement
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 8: Farm efficiency measures	**Hrs Theory 5**
Objectives	**Contents**
Familiar with and able to calculation of different farm efficiency measures.	8.1 Physical efficiency 8.2 Financial efficiency 8.3 Different ratios
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

B. Agribusiness Management	
Unit 9: Concept, definition and scope of agribusiness management	**Hrs Theory 2**
Objectives	**Contents**
Acquaint the concept and definition of agribusiness management; and Widen the scope of agribusiness management in Nepal.	9.1 Concept and definition of Agribusiness Management 9.2 Scope of agribusiness management in Nepal
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 10: Basic concept firms, plant, industry and their interrelationships of agricultural commodities	**Hrs Theory 2**
Objectives:	**Contents**
Familiar with firm, plant and industries and their relation for commercialization of agricultural commodities.	10.1 Basic concept and definitions of firms, plant and industry 10.2 Interrelationships of firm, plant and industries with respect to agricultural production
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 11: Agribusiness environment and management systems,	**Hrs Theory 2**
Objectives:	**Contents**
Develop the concept of agribusiness environment and management in agribusiness.	11.1 Discussion of Agribusiness environment for commercialization 11.2 Management systems in agribusiness

Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 12: Human resource , Organization and business management functions	**Hrs Theory 4**
Objectives:	**Contents**
Enabling human resource management in organization, business management and managerial decision process in agribusiness.	12.1 Human resource management in organization 12.2 Organization and business management functions; and 12.3 Managerial decision process in agribusiness
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 13: Preparation of financial statements, analysis and agribusiness financing; and investment appraisals	**Hrs Theory 4**
Objectives:	**Contents**
Develop the financial statements, analysis and agribusiness financing; and Using the project investment appraisal criteria.	13.1 Preparation of financial statements, analysis and agribusiness financing 13.2 Investment appraisals through use of discounted and appraisal measures
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 14: Value chain analysis: concept, mapping and approaches	**Hrs Theory 5**
Objectives	**Contents**

Developing the concept of value chain development; and Understanding the value chain development of some High Value Crops.	14.1 Value chain analysis: concept, mapping and approaches 14.2 Value chain analysis some High Value Commodities (Vegetables, Fruits, Livestock and high value crops)
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 15: Production planning in agribusiness	**Hrs Theory 4**
Objectives	**Contents**
Familiar in production planning in agribusiness; and Understanding of understanding and risk management.	15.1 Production planning in agribusiness 15.2 Uncertainty and risk management
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 16: National and International trade in High Value Crops (HVCs)	**Hrs Theory 3**
Objectives	**Contents**
Understanding of national and international; and their impact in agricultural commercialization.	16.1 Implications of National Trade of HVCs 16.2 Implication of International trade in agriculture sector of Nepal
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 17: Agricultural policies in agribusiness enterprises	**Hrs Theory 4**

Objectives	**Contents**
Familiar with Nepal Government policies in agricultural commodities commercialization and their impact agribusiness enterprises.	17.1 Agricultural policies in agricultural commercialization 17.2 Agricultural policies and their impact on agribusiness enterprises in Nepal
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
C. Cooperatives	
Unit 18: Concept of Cooperatives	**Hrs Theory 5**
Objectives	**Contents**
Understanding the definition, organizational structures, cooperative laws and by- laws; Familiar with the roles of cooperative in commercial farming	Definition Organization/ structures Roles of Cooperative in commercial farming Cooperatives laws and by- laws
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 19: Cooperative Operation in Commercial farming	**Hrs Theory 5**
Objectives	**Contents**
Describing the cooperative formation, executive members, regular meeting and saving process; Develop the format farm records keeping and double entry book keeping system; and Understanding of social auditing and regular auditing of cooperative.	Formation of Cooperative and its executive members Regular meetings and saving Record keeping and double entry record keeping Social auditing Regular auditing in cooperative

Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 20: Role of Cooperative in Agricultural Commercialization	**Hrs Theory 5**
Objectives	**Contents**
Familiar with contractual farming, cooperative farming and cooperating marketing; and Understanding the cooperative development in agriculture commercialization in Nepal.	Contractual Farming through Cooperative Cooperative farming Cooperative Marketing Cooperative development in agriculture commercialization in Nepalese experience
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources**: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Farm Management, Agribusiness Management and Cooperative Practical

Farm Management, Agribusiness Management and Cooperative Practical	**Hrs Practical: 64 Hrs**
Farm Management	
Practical 1: Profit maximization	**Hrs : 4**
Objectives	Contents
Showing the optimum inputs use and maximization of profit by using one input	Determination of optimum input use and maximization of profit using one input
Practical 2: Least cost combination of inputs	**Hrs :4**
Objectives	Contents
Graphical presentation inputs combination for showing least cost combination	Least cost combination of inputs
Practical 3: Revenue maximization	**Hrs : 4**

Objectives	Contents
Principle of optimum enterprise combination for revenue maximization	Revenue maximization through optimum enterprise combination
Practical 4: Farm record keeping and farm inventory	**Hrs : 4**
Objectives	Contents
Able to prepare farm records and farm inventory keeping	Farm record keeping and preparation of farm inventory
Practical 5: Computation of depreciation	**Hrs : 4**
Objectives	Contents
Knowing the different methods of depreciation calculation	Computation of depreciation of farm assets
Practical 6: Balance Sheet of a farm	**Hrs : 4**
Objectives	Contents
Preparation of balance sheet of a farm before starting and at the end of year.	Preparation of Balance Sheet of a farm
Practical 7: Income Statement of farm	**Hrs : 4**
Objectives	Contents
Able to prepare of Income Statement of a farm	Preparation of Income Statement of farm
Practical 8: Farm efficiency measures	**Hrs :4**
Objectives	Contents
Analyzing the both physical and financial efficiency measures	Farm physical efficiency measures Farm financial efficiency measures
B. Agribusiness Management	
Practical 9: Production chain, market chain and supply chain	**Hrs : 4**

Objectives	Contents
Identify the production chain, market chain and supply chain for sustainability of value chain development.	Analysis of production chain, market chain and supply in value chain development in agribusiness management
Practical 10: Backward and forward linkages	**Hrs :4**
Objectives	Contents
Completion of backward and forward linkage of agricultural commodities.	Analysis of backward and forward linkages of major agricultural products
Practical 11: Preparation and analysis of profit and loss statement – A case study	**Hrs : 4**
Objectives	Contents
Developing the profit and loss statement	Preparation and analysis of profit and loss statement – A case study
Practical 12: Investment appraisals	**Hrs : 4**
Objectives	Contents
Showing the project appraisal criteria	Investment appraisals through discounted cash flow measures of project worth
Practical 13: Value chain development	**Hrs : 4**
Objectives	Contents
Understanding the value chain development and showing the relationship of chain actors.	Value chain mapping of major agricultural subsectors
Practical 14: SWOT analysis of major agricultural subsectors	**Hrs : 4**
Objectives	Contents
Showing every chain actors SWOT.	SWOT analysis of major agricultural subsectors
C. Cooperative	
Practical 15: Social auditing	**Hrs : 4**

Objectives	Contents
Enabling the social auditing of cooperative	Process of social auditing in cooperative operation
Practical 16:Finacial auditing	**Hrs : 4**
Objectives	Contents
Enabling the financial auditing of cooperative for smooth running	Financial auditing of cooperative at the end of year

Aquaculture and Fisheries

Credit hours: (2+1) hrs/week **Full marks:** 100

Total hours: 128

Theory: 64 hours

Practical: 64 hours

Course Description

This course provides basic knowledge of Fish, fisheries, aquaculture, desirable characters fish and biology of cultivated aquaculture species. This course equip the students with basic knowledge and skill about the principles and practices of aquaculture including fish farming, cage fish culture, fish breeding, management of common of disease and parasites, live transportation and marketing of fish.

Course Objectives

This Course has the following Objectives:

explain the importance of Aquaculture,

skill on different types fish farming system,

- describe basic knowledge of cultivated and food fishes of Nepal,
- demonstrate importance, knowledge of natural water body pond fish farming and management,
- Control management of common fish disease and marketing channel.

Minimum Standards

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

Text and Reference books

1. Principles of Aquaculture, M.K. Shrestha and N.P. Pandit
2. Fish Farming in Nepal , K.T Augusty
3. Fish Farming Hand Book, Fishing news book, Brown and Gratzek
4. Ichthyology of Nepal, T.K. Shrestha
5. Introduction to Fish Culture, T.K Shrestha and D.K. Jha
6. Elementary Guide to Fish Culture in Nepal, E. Woynarovich

Course:	**Aquaculture and Fisheries**
Unit- 1 Introduction	**Hrs. Theory : 10**
Objectives	Contents
• Define fish, fisheries and aquaculture • classification fishes of Nepal • General morphology, desirable characters for culture practices • Scope and importance of fish culture.	1.1 Definition of Fish, fisheries and aquaculture 1.2 General character of Fish 1.3 General morphology of Fish: external features, scale and fin of fishes 1.4 Principles, scope and importance of aquaculture in Nepal 1.5 Taxonomy of the fishes of Nepal 1.6 Desirable characters of fish for culture 1.7 Biology of cultivated indigenous and exotic fish species
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit-2 River and lake fisheries	**Hrs theory : 10**
Objectives	Contents
Define and classification of natural water body Rare and endangered species stoking for management Use of natural water body by different types of farming operation.	2.1.1 Classification of river lakes and assessment of natural water body 2.1.2 Fish culture in natural water body 2.2 Cage and pen fish culture 2.2.1 General consideration for cage and pen 2.2.2 Types of cage 2.2.3 Design and construction of cages 2.2.4 Cultivable species 2.2.5 Farming operations 2.2.6 Preservation and management of fish and fisheries
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Unit 3 Pond fish culture	**Hrs theory : 30**
Objectives	Contents
Define and classification of different types fish farming system Cultivable and non cultivable fish pre-stoking and post-stoking management practices Control of aquatic weed and predatory fishes.	3.1 Pond types and construction Earthen pond 3.1.1 Cement pond 3.2 Commonly available fish species 3.2.1 Indigenous 3.2.2 Exotic 3.3 Fish feeds 3.3.1 Natural feeds 3.3.2 Supplemented feeds 3.3.3 Complete feeds 3.4 Techniques to develop natural feeds 3.5 Types of fish culture 3.5.1 Monoculture 3.5.2 Poly-culture 3.5.3 Integrated fish culture 3.5.4 Fish culture in paddy field 3.5.5 Running water culture 3.6 Cultural practices and management of pond fish culture 3.7 Stoking, pre and post stoking operations and management 3.8 Fish predators and their control
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 4 Fish breeding	**Hrs T Hrs theory: 15**
Objectives	Contents
• Define fish breeding, brood fish and their management • different types of breeding operation • Conditioning and transport of fish seed.	4.1 Role of fish seed in fish culture 4.1.1 Brood stock management 4.1.2 Types fish breeding 4.1.3 Natural, semi-artificial and artificial breeding 4.1.4 Induced breeding 4.1.5 Spawning of fish

	4.1.6 Incubating and hatching 4.1.7 Hatchling and rearing 4.1.8 Transfer to nursery pond
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 5 Live fish transportation	**Hrs theory: 5**
Objectives	Contents
• Define conditioning • Methods packing and use number of fish seed in packet or volume of water.	5.1 Conditions in transport of live fish 5.2 Causes of mortality in transportation 5.3 Condition of fish before transportation 5.4 Methods of packing and transport 5.5 Use of chemicals
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 6 Common fish diseases and parasites	**Hrs theory: 15**
Objectives	Contents
• Introduction of infectious and non-infectious fish disease • common fish disease, causal organism, symptoms and control measures of different fish diseases.	6.1 Common fish parasites and diseases in Nepal Causes and etiology 6.1.1 Symptoms and species affected 6.1.2 Types of fish disease, infectious and non infectious 6.2 Protozoan fish disease ,causal organism, symptom and control measures 6.3 Fungal fish disease ,causal organism, symptom and control measures 6.4 Bacterial fish disease ,causal organism, symptom and control measures

	6.5 Worm and crustacean fish disease ,causal organism, symptom and control measures Non infectious diseases caused by water quality, nutrional and control measures.
Evaluation Methods: Oral and written test, assignment	**Teac Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 7 Marketing fish	**Hrs theory: 5**
Objectives	Contents
Introduction of fish marketing marketing channel Benefit cost analysis.	7.1 Packaging 7.1.1 Farm gate selling 7.1.2 Distant market selling 7.2 Pricing 7.3 Selling 7.4 Recording 7.5 Benefit cost analysis
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Practical

Aquaculture and Fisheries Practical	**Hrs Practical : 30**
Practical 1: Identify external and internal body parts of fish	**Hrs : 2**
Objectives	Contents
• To know external internal organs and their functions	External and internal organs of fish
Practical 2: Identify cultivated fish species	**Hrs 1**
Objectives	Contents
• Identification of cultivated fish species	Collect and identify of cultivated fish species
Practical 3: Lay-out fish pond	**Hrs 2**
Objectives	Contents
Site selection Measurement of area and volume of pond water.	Site selection and pond and lay-out different types of fish pond Measurement of area and volume of pond water.
Practical 4: Handle fish culture equipment safely	**Hrs 1**
Objectives	Contents
Arrangements of equipment in lab Safely.	Arrangements of equipment in lab
Practical 5: Take out the pituitary gland of fish	**Hrs 1**
Objectives	Contents
• To know location and functions of PG.	Dissecting tools
Practical 6: Preserve pituitary gland, make PG injection and apply to the fish	**Hrs 2**
Objectives	Contents
Breeding equipment	Dissecting tools

	Breeding equipment
Practical 7: Make use of water filtering structures/drainage devices	**Hrs 1**
Practical 8: Make bamboo cage	**Hrs 1**
Practical 9: Make bamboo gates for paddy fish culture	**Hrs 1**
Practical 10: Carryout fish culture practices	**Hrs 1**
Practical 11: Manage fish pond	**Hrs 1**
Practical 12: Maintain water level of fish pond	**Hrs 1**
Practical 13: Fertilize/manure fish pond	**Hrs 1**
Practical 14: Feed formulation and feeding of fish	**Hrs 1**
Practical 15: Identify/control aquatic weeds	**Hrs 1**
Practical 16: Collect/identify/control common parasites of fish	**Hrs 1**
Practical 17: Identify/treat/control common diseases of fish	**Hrs 1**
Practical 18: Identification of plankton	**Hrs 1**
Practical 19: Protect pond from predators/flood/erosion	**Hrs 1**
Practical 20: Carryout activities related to fish breeding	**Hrs 1**
Practical 21: Handle fingerlings	**Hrs 1**
Practical 22: Fertilize/manure fish pond	**Hrs 1**
Practical 23: Measure fish growth	**Hrs 1**
Practical 24: Carryout pond mud analysis	**Hrs 1**
Practical 25: Harvest of fish	**Hrs 1**
Practical 26: Fish marketing	**Hrs 1**
Practical 27: Measure fish growth	**Hrs 1**

Statistics and Computer Application

Credit hours: (2+1)/week **Full Marks: 100**

Total hours: 128

Theory: 64

Practical: 64

Course Description

This course is divided into two parts (a) Elementary statistics and (b) Computer application. Part one provides a basic overview of the elementary statistics and part two provides computer application in agricultural sciences. Course is intended to give knowledge on introduction to statistics, probability, collection, classification and Tabulation diagrams and graphs, central tendency, measure of dispersion, correlation coefficient in elementary statistics and in computer application, 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

- 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.
- 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

Mahajan B.K. Method of Biostatistics

Fundamentals of Geographic Information System – Michael E. Demers

GIS for Beginners – ICIMOD

Introduction to ArcView GIS – ESRI

Getting to know ArcView GIS – ESRI

Principles of GIS – Peter A. Burrough and Rachael A. McDonnell

Course: Statistics and Computer	**Hrs. theory 64** **Hrs. Practical 64**
Part I: Statistics	**Hrs. theory 32**
Unit 1 ***: Bio-Statistics***	**Hrs.theory 10**
Unit 2: Elementary Statistics, Permutation, combination and binomial Expression	**Hrs.theory 20**
2.1: Probability	**Hrs. theory 4**
Objectives	Contents
Objectives	Contents
Describe the basic counting principle. Define probability (classical and empirical) Find the permutation of n-objects taken "r" at a time. Prove and use addition and multiplication theorem of probability. Find the combination of n-objects taken "r" at a time, When all objects are different. Explain and use binomial probability distribution formula $P(r) = c(n, r)\, p^r q^{n-r}$ Find the combination of n- objects taken "r" at a time when all subjects are same. Define permutation and combination of a set of objects. Use the relation P (n, r) and C (n, r) with its properties. Prove the binomial theorem.	Introduction of basic principle of counting. Definition of probability (classical and empirical) Definition of permutation Formula for finding permutation of n- objects taken r at a time. Proof and use addition and multiplication theorem of probability Application of formula in related problems Explanation and use binomial probability distribution formula $P(r) = c(n, r)\, p^r q^{n-r}$ Permutation of repeated use of same objects in an arrangement. Exercise XVI (1) and (2) No.1 to 5 only from textbook of grade 11. Meaning of combination. Application of formula in related problem of combination. Binomial theorem (Without proof). 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, written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams Class presentation, teacher led discussion, demonstration of solution, illustration through practical examples.

2.2: Introduction to statistics (Revision only)	**Hrs theory 2**
Objectives	Contents

Evaluation methods: Written test exams and viva.	**Teaching/Learning activities and resources:** Classroom discussion, instruction, self-study, application of statistical methods textbook.
2.3: Collection, classification and Tabulation diagrams and graphs (Revision only)	**Hrs theory 3**
Objectives	Contents
Collect data (primary and secondary) Classify and tabulate data. Prepare frequency table (ungrouped and grouped form) Represent data on simple, multiple, Sub divided, percentage bar diagram and pie diagrams. Represent data on histogram, frequency polygon, frequency curve and ogive curve	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 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.
2.4: Central tendency	**Hrs theory 3**
Objectives	Contents
Define central tendency 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.
2.5: Measure of dispersion	**Hrs theory 6**
Objectives	Contents
Calculate range, mean deviation from mean, median and mode, quartile deviation and standard deviation for ungrouped and grouped data mathematically Use Lorenz's curve to find the variability of two series Compute coefficient of range, mean deviation, quartile deviation, and variation for ungrouped and grouped data mathematically	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 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.
2.6: Correlation Coefficient	**Hrs theory 4**
Objectives	Contents
Define the concept of correlation. Define correlation method by drawing Scatter diagram. 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.

Part II: Computer application	**Hrs. theory 32 Hrs. Practical 32**
Unit 1 Introduction to computer	***Hrs. theory 5***
Objectives	Content

Explain about the generation of computers. List hardware and peripherals of computer List the available software in general use. Write about memory and data storage in computer Discuss about operating system in computer	• Generation of computers • 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
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 2 Word Processing	**Hrs. theory 6**
Objectives	Content
Create word document in computer. Format the document Edit the document 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 6**
Objectives	Content
Prepare a schema of data tabulation Enter data in spreadsheet Format the excel sheet Do calculation using formula in spreadsheet Prepare charts based on entered data	• Data tabulation • Data entry • Formatting, editing, charting calculations, formulas • 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

Unit 4 Presentation and Graphics	**Hrs. theory 6**
Objectives	Content
Prepare slides for presentation Apply different design schemes in slides Apply different animations for the objects Edit the slides 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
Unit 5 Email, Internet, Virus protection	**Hrs. theory 4**
Objectives	Content
Explain about Email Explain about Internet Explain about website Explain about virus and anti-virus system	System of Email Internet, URL, WWW, http Virus and virus protection mechanism: Norton, SVG…
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 6 Introduction to GIS	***Hrs. theory 5***
Objectives	Content
Define GIS. Answer "What GIS can answer" List the components of GIS Define GIS terminologies. 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

Statistics Practical

Course: Statistics Practical	Lab Hrs. 16
Practical 1: collection, Classification and Tabulation diagrams and graphs	**Hrs. practical 6**
Objectives	*Contents*
Prepare frequency tables (Individual, discrete and continuous). Draw simple subdivided, multiple and percentage bar diagrams. Draw pie charts and pictograms. Represent data on histograms, frequency polygons, frequency curve and Ogives.	Classification and tabulation of data. Presentation of data into simple bar diagrams, subdivided bar diagrams, multiple diagrams and percentage bar diagrams. Presentation of data into Pie charts and pictograms. Presentation of data into histograms, frequency polygons, frequency polygons and ogives.
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in the field.	**Teaching/Learning activities and resources:** Field visit, Group discussion, textbooks and reference books, journals and publications.
Practical 2: Central tendency	**Hrs. practical 6**
Objectives	*Contents*
Calculate mean of individual and grouped data Calculate median mathematically and graphically. Calculate the mode, quartiles, deciles and percentiles mathematically	Calculation of mean from individual and grouped data. Calculation of median from individual and grouped data mathematically and graphically. Calculation of the mode, quartiles, deciles and percentiles.

Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in the field.	**Teaching/Learning activities and resources:** Field visit, group discussion, textbooks and reference books, journals and publications.
Practical 3: Measure of dispersion	**Hrs. practical 4**
Objectives	*Contents*
Calculate mean deviation from central values. Calculate standard deviation of individual and grouped data. Find the coefficient of variation.	Calculation of mean deviation from mean, median and mode. Calculation of standard deviation from individual and grouped data through shortcut method and direct method. Calculation of coefficient of variation.
Evaluation Methods: Written tests, home assignments and presentation, participation/interaction in the field.	**Teaching/Learning activities and resources:** Field visit, Group discussion, textbooks and reference books, journals and publications.

Computer Application Practical:

Course: Computer Practical	**Lab Hrs 16**
Practical 1: Typing Tutor	Hrs 2
Objective	*Content*
Complete typing tutor	Type English Fonts Type Nepali Fonts
Practical 2: Work on MS Word 2006	Hrs 5
Objective	*Content*
Carry hands on Microsoft Word	Document creation Document formatting Document saving Document editing

	Document printing
Practical 3: Work on MS Excel 2006	Hrs 3
Objective	*Content*
Carry tutorials on MS Excel	Data entry in spreadsheet Data analysis Graphical presentation of data Tabulation and Printing
Practical 4: Work on MS Power point 2006	Hrs 3
Objective	*Content*
Carry tutorials on MS Power Point	Slide preparation Design, multimedia, proofreading, editing Saving and Opening Presentation and printing
Practical 5: Work on ArcView 3.x	Hrs 3
Objective	*Content*
Carry hands on ArcView 3.x	Layer creation Editing GIS data Database management in GIS Sybolization and Labelling Layout preparation and Printing

Introductory Animal Husbandry

Credit hours: 2+1 hrs/week **Full Marks: 100.00**

Toal hours: 128

Theory: 64 hrs

Practical: 64 hrs

Course Description

This course provides basic knowledge in animal husbandry including the common terminologies, animal housing, feeding, breeding management and other general farm operation

Course Objectives

This Course has the following objectives:

- Provide basic information about livestock production system
- Demonstrate the techniques for improved livestock management practices.
- Demonstrate the method of feeding, breeding and rearing farm animals
- Establish livestock farm with minimum guidance of experts
- Generate ideas of self employment by animal rearing
- Work as a middle level technician in livestock farm
- Provide technical service to private and government farms

Minimum Standards

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

Books and references:

Banerjee, C.G.1991. A Text Book of Animal Husbandry (7th ed). Oxford and IBH

Publishing Co.,

Prasad, J. 1997. Animal Husbandry and Dairy Science. Kalyani Publishers

Sastry, N.S.R., C.K. Thomas and R.A. Singh. Livestock Production and Management(3rded),Kalyani Publishers

Introductory Animal Husbandry	**Hrs. Theory : 64 Hrs. Practical : 64**
Unit- 1 Introduction to animal husbandry	**Hrs theory : 3**
Objectives	Contents
Classify common domestic animals Explain importance and scope of livestock production in Nepal Explain livestock population, distribution and its contribution to the GDP in Nepal Explain livestock as a component of mixed farming system	Common terminology of animal husbandry Zoological classification of common domestic animals Importance and scope of livestock production in Nepal Livestock population, distribution and its contribution to the GDP in Nepal Livestock as a component of mixed farming system
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit-2 Physiology of animal	**Hrs theory : 4**
Objectives	Contents
Explain the digestive organs of ruminants Explain the digestive organs of non-ruminants Explain animal blood- functions of blood and components of blood	The digestive organs of ruminants The digestive organs of non-ruminants Animal blood; functions of blood and components of blood
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 3. Mechanism of animal reproduction	**Hrs Theory 4**
Objectives	Contents

Expalin male reproductive organs Expalin female reproductive organs Expalin hormones and their role in female reproductive mechanism Expalin the sexual cycle; detection of heat, ovulation and fertilization	Male reproductive organs Female reproductive organs Hormones and their role in female reproductive mechanism The sexual cycle; detection of heat, ovulation and fertilization
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 4. Animal breeding and AI	**Hrs Theory 4**
Objectives	Contents
Explain selection of animal and traits of selection Explain systems of breeding Explain selection methods Explain artificial insemination and its advantages Perform insemination techniques	Selection of animal and traits of selection Systems of breeding Selection methods Artificial insemination and its advantages Collection, examination and evaluation of semen Insemination techniques
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 5 Mammary gland and lactation	**Hrs Theory 4**
Objectives	Contents
Explain anatomy of mammary gland Lactation, hormonal regulation, milk secretion and let down Explain milk and its composition	Anatomy of mammary gland Lactation, hormonal regulation, milk secretion and let down Milk and its composition

Perform milking of cow and buffalo and clean milk production	Milking of cow and buffalo and clean milk production
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 6 Animal nutrition and feed stuffs	**Hrs Theory 10**
Objectives	Contents
Classify feed stuffs; roughages and concentrates Identify and use conventional and unconventional feeds in Nepal Introduce nutrients of feeding stuffs Explain role of water, carbohydrates and lipids, proteins and amino acids, minerals and vitamins Cultivate common legumes and cereal fodders Introduce the pasture/range and the high hills animal grazing systems	Classification of feed stuffs; roughages and concentrates Conventional and unconventional feeds in Nepal Introduction to the nutrients of feeding stuffs Water, carbohydrates and lipids Proteins and amino acids Minerals and vitamins Cultivation practices of common legumes and cereal fodders Introduction to the pasture/range and the high hills animal grazing systems Commonly grown fodder trees and their role in livestock feed supply Agro forestry, silvi pastoral system and its use in Nepal
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 7 Common cattle and buffalo breeds	**Hrs 10**

Objectives	Contents
Identify cattle and buffalo breeds	Milch breeds of cattle Dual purpose breeds of cattle Draughts breeds of cattle Indian and indigenous Nepalese Milch buffaloes
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 8 Common breeds of swine	**Hrs Theory 2**
Objective	Contents
Explain common breeds of swine, their characteristics and production	Common breeds of swine, their characteristics and production
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 9 Common breeds of sheep and goat	**Hrs Theory 3**
Objective	Contents
Identify common breeds of sheep and goat , their characteristics and production	Common breeds of sheep and goat , their characteristics and production
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 10 Rabbit farming	**Hrs theory 2**
Objectives	Contents

Raiseify rabbits, identify and explain rabbit farming, common breeds, breeding and nutritional management	Rabbit farming, common breeds, breeding and nutritional management
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 11 Poultry production	**Hrs theory 8**
Objectives	Contents
Explain poultry production and its techniques	Nomenclature and breeds of fowl Classification of fowls; American, Asiatic, English and Mediterranean class Formation, structure and nutritive value of eggs Hatching eggs and management of incubator Management of chicks in the brooder Housing and equipment
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 12 Care and management of livestock	**Hrs theory 6**
Objectives	Contents
Care and manage livestock	Care and management of newly born calf and kids, piglet etc Care and management of pregnant animal Care and management of breeding bull, buck, boar etc Care and management of lactating animals

	Identification of animals Debudding, dehorning, ducking and castration of farm animals Farm books and record keeping
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Practicals

Practicals	**Hrs Practical : 64**
Practical 1: Identification of common breeds of cattle, buffalo, goat, sheep, and poultry birds	**Hrs : 2**
Objective	Contents
Identify common breeds of cattle, buffalo, goat, sheep, and poultry birds	Common breeds of cattle, buffalo, goat, sheep, and poultry birds
Practical 2: Study on digestive system of ruminants	**Hrs 2**
Objective	Contents
Acquire the practical knowledge of digestive system of ruminants	Digestive system of ruminants
Practical 3: Study on digestive system of non-ruminants	**Hrs 2**
Objective	Contents
Acquire the practical knowledge of digestive system of non-ruminants	Digestive system of non-ruminants
Practical 4: Study on reproductive systems of male and female animals and poultry birds	**Hrs 2**

Objective	Contents
Introduce reproductive systems of male and female animals and poultry birds	Reproductive systems of male and female animals and poultry birds
Practical 5: Identification of farm animals and poultry birds	**Hrs 2**
Objective	Contents
Identify farm animals and poultry birds	Identification techniques of farm animals and poultry birds
Practical 5: Treating animals against external and internal parasites and worms	**Hrs 4**
Objective	Contents
Treat animals against external and internal parasites and worms	Treatment of animals against external and internal parasites and worms
Practical 6 : Practice on routine farm operations: weighing, debudding, dishorning, ducking and castration	**Hrs 4**
Objective	Contents
Practice routine farm operations: weighing, debudding, dishorning, ducking and castration	Routine farm operations: weighing, debudding, dishorning, ducking and castration
Practical 7 : Identification of common grasses and forage legumes	**Hrs 2**
Objective	Contents
Identify common grasses and forage legumes	Identification of common grasses and forage legumes
Practical 8 : Judging animals for selection using different scoring methods	**Hrs 2**
Objective	Contents
Judge animals for selection using different scoring methods	Judgment of animals for selection using different scoring methods

Practical 9 : Feed formulation using thumb's rules	**Hrs 4**
Objective	Contents
Formulate ration using thumb's rules	Formulate ration using thumb's rules
Practical 10: Record keeping practices for farm animals	
Objective	Contents
Keep record of farm animals	Record keeping practices for farm animals
Practical 11: Visit DLSO to observe and experience about Artificial Insemination	**Hr 4**
Objective	Contents
Visit DLSO to observe and experience about Artificial Insemination practices.	Visit DLSO to observe and experience about Artificial Insemination practices.

Principles and Practices of Agronomy

Total hours: 3+1/week: 160 hours **Full Marks: 100**

Theory: 96 hours

Practical: 64 hours

Course Description:

This course provides the basic concepts agronomy for successful crop production. The course includes introduction to agriculture and agronomy, climatic factors influencing crop production, old and modern concept of tillage, plant nutrition, manures and fertilizers, cropping system, water management, weed management, seed production technology, Problems and characteristics of hill, rainfed and organic agriculture.

Course Objectives

This Course has the following Objectives:

Explain the climate, tillage and plant nutrients affecting the growth and productivity of crops.

Enable to apply manure and fertilizer and water to the crops for successful crop production.

Enable to identify the major weeds of crop and apply the weed management practices.

Enable to demonstrate the knowledge for seed production of crops.

Explain the problems and characteristics of hill, rainfed and organic agriculture.

Minimum Standards

Students must secure 40% marks in theory and 60 % accuracy in practical.

Text and Reference books

Reddy, T. Y. and G.H. C. Reddy. 1994. Principles of Agronomy, Kalyani publisher

Reddy, S. R. 2007. Principles of Agronomy. Kalayani publisher.

Sankaran, S. and V. T. S. Mudalier. 1991. Principles of Agronomy. The Banglore printing and publishing Co.

Sharma, G. and P.B. Thapa. 2005. Proceedings of National Workshop on Organic Agriculture and Food security. Kathmandu, Nepal.

Course: Principles and Practices of Agronomy	**Hrs. Theory : 96 Hrs. Practical : 64**
Unit:1. Introduction to agriculture and agronomy	**Hrs theory : 8**
Objectives	**Contents**
Define agriculture and agronomy Differentiate between subsistence and commercial agriculture Explain the contribution of agronomy in solving food problems Define and explain declining food security in Nepal Classify the agronomical crops.	Definition of agriculture, agronomy, subsistence agriculture, commercial agriculture, food security and causes food insecurity in Nepal. Role of agronomy in solving food problems. Agronomic Classification of crops, classification based on growing seasons, special purpose classification of crops.
Evaluation Methods: oral, written tests and assignment.	**Teaching /Learning activities and resources:** Classroom instruction, visuals, field observation, textbooks and reference books
Unit:2. Climate	**Hrs theory : 12**
Objectives	**Contents**
Define weather, climate, meteorology and agro meteorology. Explain the elements of climate and their effects on crop growth Explain the climates of Nepal with reference to crop distribution Explain the climate change and its impacts on agriculture.	Definition of weather, climate, meteorology and agro meteorology. Elements of climate, effects of solar radiation, temperature, rainfall, snowfall and humidity on crop growth. Climatic regions of Nepal and crop distribution based on climate regions. Climate change and global warming, reasons of climate change and impacts of climate change on agriculture.
Evaluation Methods: Oral tests, written tests, assignments.	**Teaching /Learning activities and resources:** Class rooms instruction, visuals, observation of meteorological station, field observation. Text books, reference books.

Unit: 3. Plant nutrition	**Hrs, Theory: 18**
Objectives	**Contents**
State the essentiality, requirement and sources of plant nutrients. Explain the functions and deficiency symptoms of macro and micro nutrients. Differentiate between soil fertility and soil productivity and explain the agronomic practices to maintain soil fertility and soil productivity.	Essential elements. Criteria for essentiality of plant nutrients Classification of plant nutrients: structural, macro, primary, secondary and micro nutrients Functions and deficiency symptoms of macro and micro nutrients in crops Sources of plant nutrients, definition of soil fertility and soil productivity Agronomic practices for maintaining soil fertility and soil productivity
Evaluation Methods: oral test, written test, assignments and collection of deficiency symptoms of crops specimen.	**Teaching /Learning activities and resources:** Class room instruction, visual of plant specimens, field visit, collection and identification deficiency symptoms of nutrients in crops, text books and reference books.
Unit 4 Manure and fertilizer	**Hrs Theory 10**
Objectives	**Contents**
Explain the importance and uses of organic manures, green manuring crops, biofertilizers and chemical fertilizers. Enable to apply manures and fertilizers in crops	Manures: importance, nutrient contents of organic manures like FYM, compost, Poultry manure, Oilseed cakes, sewage and city waste and their use in crop production. Green Manuring crops: importance, nutrient contents and types of green manuring crops used in crop production. Biofertilizer: importance and uses of Azotobacter, Rhizobium, Azolla, mycorhizae, in crop production

	Chemical Fertilizers: importance, nutrient contents and uses of common chemical fertilizers in crop production. Methods and time of fertilizer application.
Evaluation methods: oral test, written test and assignments	**Teaching/ learning activities and Resources** Classroom instruction, visuals, field observation, textbooks and reference books
Unit:5 weed management	**Hrs theory :6**
Objectives	Contents
Define weed Explain the losses and benefits of weeds Explain the control of weeds in crop production.	Definition, losses and benefits of weeds, Managements of weeds: prevention, eradication and control. Physical, cultural, biological and chemical methods of weed control with their relative merit and demerits.
Evaluation Methods: oral, written tests and assignment.	**Teaching /Learning activities and resources: :** Classroom instruction, visuals, field observation, textbooks and reference books
Unit: 6 Tillage	**Hrs theory : 6**
Objectives	Contents
Define tillage, tilth and explain the objectives of tillage. Explain primary, secondary and inter tillage Explain the conventional and conservation tillage with their advantage and disadvantage.	Definition of tillage and tilth, objectives of tillage, Primary, secondary and inter tillage, Conventional tillage: advantages and disadvantages. Conservation tillage: minimum, Zero and surface mulch tillage with their advantages and disadvantages.
Evaluation Methods: oral, written tests and assignment.	**Teaching /Learning activities and resources:** Classroom instruction, visuals, field observation, textbooks and reference books
Unit: 7 Cropping system	**Hrs Theory: 10**
Objectives	Contents

Define sole crop, monoculture, cropping pattern, cropping system and farming system. Explain the types of multiple cropping system with their importance in Nepal Explain principles of crop rotation and advantages of crop rotation.	Definition of sole crop, monoculture, cropping pattern, cropping system and farming system. Multiple cropping: sequence cropping; inter cropping, mixed cropping and relay cropping and their importance in Nepal. Methods to calculate cropping index, cropping intensity and land equivalent ratio. Crop rotation: definition, principles and advantages of crop rotation.
Evaluation Methods: oral, written tests and assignment.	**Teaching /Learning activities and resources:** Classroom instruction, visuals, field observation, textbooks and reference books
Unit: 8 Water management	**Hrs theory :15**
Objectives	Contents
Explain the role of water and water requirements of crops. Explain the methods of irrigation, scheduling irrigation and drainage in crop production. Explain water harvesting and soil water conservation techniques.	Function of water in plants and water requirements of crops. Methods of irrigation: Surface, sub surface, sprinkler and drip irrigation. Scheduling irrigation: soil moisture depletion approach, IW/ CPE approach and critical growth stage approach. Drainage: adverse effects of water logging, types of drainage. Water harvesting: importance of water harvesting, methods of rain water harvesting, Soil erosion: losses due to erosion, factor affecting erosion and soil conservation methods including sloping agriculture land technology (SALT) for soil and water conservation.
Evaluation Methods: : oral, written tests and assignment.	**Teaching /Learning activities and resources:** Classroom instruction, visuals, field observation, textbooks and reference books
Unit: 9 Seed and seed quality	**Hrs theory :12**
Objectives	Contents
Define seed and explain the importance and scope of quality seed.	Definition of seed and planting materials, differences between seed and grain,

Explain the types of seed, seed germination and purity test, seed dormancy, basic principles of seed production and seed certification in Nepal.	Characteristics of quality seed and its importance and scope in Nepal. Types of seed produced in Nepal, seed germination and purity tests, seed dormancy, basic principles of seed production and seed certification in Nepal.
Evaluation Methods: oral, written tests and assignment.	**Teaching /Learning activities and resources:** Classroom instruction, visuals, Laboratory tests, textbooks and reference books
Unit 10 Hill, Rainfed and Organic agriculture	**Hrs Theory: 6**
Objectives	Contents
Define hill, rainfed and organic agriculture. Explain the major constraints of hill, rainfed and organic agriculture Explain the characteristics and components of hill, rainfed and organic agriculture.	Definition of hill, rainfed and organic agriculture. Major constraints of hill, rainfed and organic agriculture in Nepal. Characteristics and components of hill, rainfed and organic agriculture.
Evaluation Methods: oral, written tests and assignment.	**Teaching /Learning activities and resources:** Classroom instruction, visuals, textbooks and reference books

Agronomy Practicals

Practicals	**Hrs Practical : 64**
Practical 1: Identification of seeds of agronomical crops	**Hrs : 4**
Objectives	Contents
Collect and identify the seeds of agronomical crops	Visit to farmers field, Agronomy farm. Collect the seed of field crops Identify the seed of field crops
Practical 2: Seed germination test	**Hrs : 4**
Objectives	Contents

Perform the germination test of seed.	Seed germination requirements Methods used in lab and field Characteristics of normal and abnormal seedling Seed germinator
Practical 3: Seed purity test	**Hrs : 6**
Objectives	Contents
Perform the purity test	Seed purity Seed purity board weed seed inert materials
Practical 4: Calculation of seed requirement based on germination, purity	**Hrs : 4**
Objectives	Contents
Calculate the seed requirement of crops based on germination and purity	Recommended seed rate Real value of seed Area to be seeded Seed adjustment
Practical 5: study of meteorological data recording.	**Hrs : 2**
Objectives	Contents
Perform meteorological data recording.	Visit meteorological observatory Observe the equipments for recording temperature, rainfall, solar radiation and humidity Draw figure/ diagram of equipment Working procedure of equipment
Practical 6. Identification of common fertilizers and manures available.	Hrs**: 4**
Objectives:	Contents:
Indentify the fertilizers and manure and	Fertilizer and manure

know the nutrients contents of them.	Physical characteristics of manure and fertilizer Nutrient content of manures and fertilizers
Practical 7. Identification of deficiency symptoms of plant nutrients.	Hrs: 4
Objectives:	Contents:
Familiar with deficiency symptoms of major plant nutrients in the field crops	Visit to field crops Identify the deficiency symptoms of plant nutrients Collection of samples of deficiency symptom Preparation of herbarium
Practical 8: Calculation of fertilizer dose for field crops	**Hrs: 4**
Objectives:	Contents
Calculate fertilizers needed for different crops	Nutrient content of fertilizer Recommended dose of nutrients Area to be fertilized
Practical 9: Methods of fertilizer application	Hrs: **4**
Objectives	Contents
Enable students to apply fertilizer and manures in the field	Methods and time of application Broadcasting Side dressing Band placement Foliar spray
Practical 10. Preparation of improved compost.	Hrs: **4**
Objectives:	Contents:
Prepare improved compost.	Nutrient contents of compost Methods of compost preparation Pit and heap methods, vermi-composting
Practical 11.Identification of weeds of agronomical crops	Hrs: **4**
Objectives:	Contents:
Identify the weeds of different field crops	Field visit Local name, Scientific name, Family of weeds Crop- weed association

	Weed ecology
Practical 12. Preparation of weed herbarium	Hrs**: 6**
Objectives:	Contents:
Prepare weed herbarium	Field visit Collection of weeds of different crops Identification of weeds Preservation and preparation of weed herbarium.
Practical 13. Identification of common herbicides used in weed control in Nepal.	Hrs**: 2**
Objectives:	Contents:
Familiar with herbicides application for weed control.	Types of herbicides Active ingredients of herbicides Herbicides formulation
Practical 14. **Seedbed preparation for planting seasonal crops.**	Hrs**: 6**
Objectives:	Contents:
Perform the planting of the seasonal crops	Importance of good seedbed and tilth Soil moisture content during seeding Seeding depth Crop geometry
Practical 15. Study of yield attributes of crops	Hrs **2**
Objectives:	Contents:
Know the yield attributes of crops	Yield and yield attributes Yield attributes of rice, maize, legumes and oilseed crops
Practical 16: Yield estimation of the crops	Hrs**: 4**
Objectives:	Contents:
Estimate the yield of field crops.	No. of effective tillers per unit area 1000 grain weight No. of filled grain per panicales Moisture content of seed Yield estimation in rice, maize, legumes and oilseed crops.

Plant Protection

Cradit hours: 3+1/week **Full Marks: 100**

Total hours: 160 hours

Theory: 96 hours

Practical: 64 hours

Course Description

The course covers the details of insect, diseases, and weed and their enemies of plant which has significantly reduced the crop yield. Which cover the basic concept and definition of entomology, pathology, weeds and yield depletion factors. Similarly, the general characteristics of insects, their classification, food habits, their life cycle, type of beneficial organisms, plant pathogens like fungi, bacteria, virus, viroids, nematodes, their life cycle, infectious and non-infectious diseases, plant protection measures like cultural, mechanical, biological, HPR, physical, chemical and IPM. Similarly, the course also describes about the details of pesticides like pesticide classification, mode of actions, pesticide formulations, toxicity level of pesticide, safe use of pesticide, pesticide symptoms and first aid practices, methods of pesticide application, pesticide spraying techniques, pesticide appliances, pesticide calculation and compatibilities, important crop diseases and their diagnostic symptoms, rodents, their characteristics and their management etc.

Course Objectives

This Course has the following Objectives:

General objectives: This course provides the students with basic knowledge and skill on insect pest and disease management in major fruits, vegetable, and field crops grown in Nepal.

Specific Objectives

The course also increases the general knowledge and skill on pest identification, their characteristics, food habit, life cycle and their diagnostistics characteristics.

It enhances the knowledge and practices on integrated approaches of pest management like cultural, mechanical, biological, physical, and chemical and IPM techniques of pest management.

The courses also provides the basic knowledge about pest and non-pest like rodents, birds and other wild animals which significantly reduces the corp. yield.
The course also enhances the details of chemical pesticide like classification, mode of pesticide, pesticide appliances, pesticide compatibilities, pesticide calculation technqiesu and selection of right pesticides
It also gives the knowledge about role of rodents in loss of crop including their characteristics and their effective management practices.

Minimum Standards

Students must able to develop the 40% accuracy in theory and 60% in practical

Text and Reference books

GC, Yubak, 2012. Status of pesticide use in Nepal and efforts of plant protection directorate towards the pesticide reduction. J. Plant protection society, Vol 3, 2012. Pp 1-13. John, Wiley and Sons Inc.,
Luckmann, H.W. and R.L. Metcalf. 1982. Introduction to Insect Pests Management, Management of Soil Pests. HELMITAS, Lalitpur, Nepal
Manandhar, D.N. 2006. Pesticides in Nepal. Rising Sun Printer, Teku, Kathmandu Nepal, 110p.
Neupane, F.P. 2002. Tarkari Balima Lagne kiraharuko yakikrit bebastaphan (Integrated management of vegetable insects) in Nepali. Jagadamba Press, Patandhoka, Lalitpur, Nepal. 172 p.
Neupane, F.P. 2003. Status of botanical pesticides in Nepal. In: F.P. Neupane (ed.), Proceedings of national seminar on integrated pest management in Nepal, 25-26 September 2002. Himalayan resources institute, New-Baneshwor, Kathmandu, Nepal. pp. 77-100.
Neupane, F.P. 2010. Common vegetable pest and their integrated management (In Nepali).Sajha Publisher, Kathmandu, Nepal.
Panwar, V.P.S. 1995. Agricultural Insect Pests of Crops and their Control, Kalyani
Pesticide Registration and Management Section. 2011/2012. List of Registered Pesticide of Nepal. Published by Department of Agriculture, PRMD, 47P.
Plant Protection Society 2010, Nepal, Journal of the Plant Protection Society, Volume 2 . Hisi Printing Press, Lalitpur.
Pokharel, R.R. 2055. Balibiruwaka rogharu ra tinko roktham. 2nd ed. Publishers
Singh, R.S. 1990. Plant Diseases (6th ed), Oxford and IBH Publishing Co., Ltd.
Thapa, R.B., G.C. Yubak dhwoj, B.R. Du di and B.R. Khadgi. 2001. Integrated

Tiwari K.P.; 2012, IPM-FFS Institutionalization In Nepal: A Case Study in- The Journal of Agriculture and Environment Vol:13, Jun.2012 .

Upadhyaya, N. S. 2002, Experience of community IPM in Nepal, Plant Protection Directorate, Department of Agriculture, Harihar Bhawan, Lalitpur, Nepal

Course: Plant Protection	**Hrs. Theory : 96 Hrs. Practical :64**
Unit 1: Introduction	**Hrs theory :3**
Objectives	**Contents**
Define and explain the importance and scope of entomology, plant pathology and plant protection. Explain the general concept of insect pest, non-pest, micro-organisms and weeds Define and explain the crop yield depletion factors caused by insect pest, diseases, rodents and weeds.	Definition, importance and scope of Entomology, Plant pathology and Plant protection General Concept of Microorganism, Pest, Pathogen, Diseases, Disorder, Insect, Pesticides, Rodents, Weeds Crop yield depletion factors like Insect pests, Diseases, Rodents and Weeds
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 2. Insects	**Hrs theory :8**
Objectives	**Contents**
Explain the general characteristics of insect Describe the insect classification Explain about the feeding habit of insects Explain the general life cycle of insects	General characteristics of insects Insect classification Feeding habits of insects General life cycle of insects

Define and explain the harmful and beneficial insect	Harmful insects and Beneficial insects
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 3 Plant diseases	**Hrs Theory: 8**
Objectives	**Contents**
Define the plant pathogens like fungi, bacteria, nematods, virus and viroides etc. Explain the infectious and non-infectious plant diseases Describe and explain the general symptoms of plant diseases Define and explain about the diseases cycle Explain about the factors responsible for development of plant diseases.	Plant pathogens (Fungi, Bacteria, Nematodes, Virus, Viroides etc) Infectious and non-infectious diseases General symptoms of plant diseases Disease cycle- stages in the development of a disease Factors affecting on the development of diseases
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 4 Plant protection measures against insect pest and diseases	**Hrs Theory 10**
Objectives	**Contents**
Define and explain the general principles and methods of integrated approaches of pest managements like physical,	Physical method Mechanical method Cultural method

mechanical, cultural, biological, HPR, legislative, chemical and integrated pest control methods	Biological method Genetical method/use of resistant varieties Regulatory method Chemical method Integrated pest control
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 5 Pesticides (commonly used pesticides in Nepal	**Hrs Theory 10**
Objectives	**Contents**
Define and explain the different type of pesticide which are commonly using in agriculture. They are insecticides, fungicides, nematicides, rodenticides and others	Types of pesticides used in agriculture Insecticides Fungicides Nematicides Rodenticides and others (Antibiotics, Acaricides etc)
Define and able to formulate the pesticides	Formulation of pesticides
Explain about the toxicity label of pesticides	Toxicity of pesticides
Define and explain about the safe use of pesticides and misuse practices done by farmers	Safe use of pesticides Misuse of pesticides
Explain about the pesticide poisoning symptoms and first aid measures	Pesticides poisoning symptoms and first aid measures
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 6 Methods of pesticides application	**Hrs Theory: 6**

Objectives	**Contents**
Define and explain the different methods of pesticide application like soil application, seed treatment, foliar application and post-harvest treatments	Pesticide application methods like Soil application Seed treatment Foliar application Post-harvest treatment
Evaluation Methods: Oral and written test examination	Teaching /Learning activities and resources: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 7 Plant protection equipment	**Hrs Theory: 5**
Objectives	**Contents**
Define the plant protection equipments Define and able to describe about plant protection equipments, their types, care and maintenances, trouble, cause and remedities including their calibration methods.	Introduction Sprayer and its types Dusters Care and maintenance Trouble, cause and remedy Calibration of sprayers
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 8 Pesticide calculations and pesticide compatibilities	**Hrs Theory : 4**
Objectives	**Contents**
Describe about the pesticide calculations methods Explain about the pesticide compatibilities	Pesticide calculations Pesticides compatibilities

Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 9 Important insect/mite pests of crop (cereals, legumes, oil seed, industrial, vegetables, fruits and plantation crops) and their management	**Hrs Theory: 15**
Objectives	**Contents**
Explain about the symptoms of insect damage Define and describe about important soil insect pests Define and explain the important chewing foliage insect Define and explain the important foliage sucking insect and mites Describe about the important leaf miner, stem, twig, fruit-borer insect pests.	Symptoms of insect damage Important soil insect pests Important foliage insect pests of a chewing nature Important foliage sucking insects and mite pests Important Leaf miner, stem, twig, fruit-borer insect pests
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 10 Stored grain pests and their control	**Hrs Theory: 5**
Objectives	**Contents**

Define the term stored grain insect and able to describe their identification characteristics Explain about the integrated approaches of management of storage insect pest	Stored grain insect pests and their identification Control of insect pests
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 11 Important crop diseases and diagnostic symptoms (cereals, legumes, oil seed, industrial, vegetables, fruits, plantation crops) and their management	**Hrs Theory: 14**
Objectives	Contents
Define and differentiate the fungal, bacterial, viral, viroids and nematode diseases. Explain about the important fungal, bacterial, viral,viroids and nematode crop diseases Describe about the typical diagnostic symptoms of fungal, bacterial, viral, viroids and nematode diseases Explain the common management practices of crop diseases	Diseases caused by fungi Diseases caused by bacteria Diseases caused by nematodes Diseases caused by viruses and viroides Other important disorders

Evaluation Methods: Oral and written test examination	Teaching /Learning activities and resources: Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 12 Rodents and their control	**Hrs Theory 4**
Objectives	**Contents**
Explain about the economic importance, general habits and characteristics of rodents Describe about common and practical methods of rodent control with and without chemicals	Economic importance, general habits and characteristics of rodents Rodent control with and without chemicals
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit: 13 Pesticide act	**Hrs Theory 4**
Objectives	**Contents**
Explain pesticide act, rules, regulations and standards. Aware about the listed and banned pesticide.	Current pesticide act, rules, regulations and standards. Listed and banned pesticide. Licencing process for pesticide business.
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Plant Protection Practical's

Practicals	**Hrs Practical : 64**
Plant Protection Practical	**Hrs Practical :2**

Practical 1: Identification and uses of common Plant Protection equipment and tools	**Hrs :**
Objectives	**Contents**
Identify the different types of plant protection tools, equipments and chemicals used in plant protection measures Increase the skill on use of plant protection equipments in agricultural fields.	Short introduction on Plant Protection equipments Identification of PPE equipments and tools Common functions and uses of PPE
Practical 2: General features of insects	**Hrs :2**
Objectives	**Contents**
Handle the insect for laboratory work Know the different external morphology of insect and their appendages Know about the general functions of the appendages	General external morphology of insect Insect head and their appendages Insects thorax and their appendages Insects Abdomen and their appendages
Practical 3: Growth and development of insects	**Hrs :2**
Objectives	**Contents**
Set the zoo and cup for biology study of insect Grouping the insects and classify based on metamorphosis	Insect zoo and cup study for biology study Collection of insets General life cycle of insect Insect metamorphosis Type of larva Type of pupa
Practical 4: Other insects like pests (other orthopoda)	**Hrs :2**
Objectives	**Contents**

Collect the insects other than orthopoda Define the general characteristics insects Know the general life cycle, their habit and economic importance	General characteristics of other Orthopoda Classification Some examples
Practical 5: Identification of insects feeding habits/ mouth parts of insects	**Hrs :2**
Objectives	**Contents**
Classify the insect based on their mouth parts Describe the general parts of mouth parts of different insets based on their modifications	Classify the insect based on their feeding habit with examples Illustration of different types of mouth parts Marking the general features of mouth parts of different insects
Practical 6: Identification of common insects pests	**Hrs :2**
Objectives	**Contents**
Know the different types of insects Classify the insect based on food habit, order, habitat etc Know the common name, Sc, Name, family, order and some typical mark of identification of economic pest	Collection of insects available in the local areas and different crops Grouping them based on their characteristics Classification of collected insects Indentify their common name, scientific name, order and family
Practical 7: Collection and preservation of insect pests	**Hrs :4**
Objectives	**Contents**
Develop the skill on insect collection and preservation methods	Collection of insect by different methods Importance of insect preservation Preservation methods and techniques
Practical 8: Identification, collection and preservation of insects damaged crop parts	**Hrs :2**

Objectives	**Contents**
Collect and Identify the various damage symptoms Preserve the insect's damage symptoms	Field visit Collection of insect damaged parts and based on their damage symptoms, identify insect, diseases, nutritional disorder Methods of preservation of damaged crop parts
Practical 9: Identification of disease symptoms	**Hrs :2**
Objectives	**Contents**
Identify the common diseases symptoms	Common symptoms of diseases Identification characteristics of diseases symptoms
Practical 10: Collection and preservation of diseased materials	**Hrs :6**
Objectives	**Contents**
Collection techniques and methods Preservation methods of diseased materials	Collection techniques of diseased materials from the field Preservation methods of diseases materials
Practical 11: Common pesticides available in Nepal and their label, meaning and use	**Hrs :2**
Objectives	**Contents**
Classify the pesticide Know the label and type of pesticide Define the toxicity and formulate the pesticide	Common classification of pesticide available in Nepal Type of pesticide Pesticide label Classification of pesticide Toxicity of pesticide

	Formulation of pesticide
Practical 12: Formulation and dilution of pesticides	**Hrs :2**
Objectives	**Contents**
Descirbe the common formulation of pesticide available in Nepalese market Know the common dilution methods of pesticide	Common forms of pesticide available in Nepalese market Dilution method of pesticide
Practical 13: Preparation and application of Bordeaux Mixture	**Hrs :2**
Objectives	**Contents**
Able to prepare the BM and their application methods in fruit orchard	Ingredient use in Bordeaux Mixture Method of preparation of BM Application methods of BM
Practical 14: Study and calibration of sprayers	**Hrs :2**
Objectives	**Contents**
Identify the right amount of pesticide per unit areas Learn about the pesticide calibration methods	Short introduction about pesticide calibration and its objectives Steps in pesticide calibration methods
Practical 15: Foliar application of pesticides	**Hrs :2**
Objectives	**Contents**
Learn the foliar application methods	Significance of foliar application of pesticide

Kill the foliar insect	Equipments required for foliar application
Practical 16: Soil application of pesticides	**Hrs :2**
Objectives	**Contents**
Learn the soil application methods and kill the soil insect	Significance of soil application of pesticide Equipment and materials required for soil application Methods of soil application
Practical 17: Seed treatment by pesticides	**Hrs :2**
Objectives	**Contents**
Develop the skill on seed treatment	Significance of seed treatment by pesticide Equipment and materials required for soil application Methods of soil application
Practical 18: Post-harvest treatment by pesticides	**Hrs :2**
Objectives	**Contents**
Describe the post harvest treatments in details, its objectives and methodology	Definition on post-harvest treatment Methods of post harvest treatment Significance of post harvest treatment
Practical 19: Tree-wound treatment by pesticides	**Hrs :2**

Objectives	**Contents**
Define the tree-wound treatments by pesticides Explain details on tree-wound treatment by pesticides	Significance of tree-wound treatment by pesticide Methods of tree-wound treatment
Practical 20: Use of common botanical materials as pesticides	**Hrs :2**
Objectives	**Contents**
Define botanical pesticides and able to prepare the botanical pesticide	Type of botanical materials Some good examples of botanicals using in pest managements Methods of preparation of botanicals
Practical 21: Rodents control methods	**Hrs :2**
Objectives	**Contents**
Describe and able to prepare the rodent management by chemical and non-chemical methods.	General characteristics of rodents Economic importance of rodents Rodents management
Practical 22: Precaution and safe use of pesticides, and their safe disposal	**Hrs :2**
Objectives	**Contents**
Describe about precautionary measures and safe use of pesticides Safe disposal of chemical pesticides	Precautions while using the chemical pesticides Importance of Personal protective equipments Safe disposal of pesticides and their containers

Practical 23: Field visit to identify the plant disease and insect damage	**Hrs :2**
Objectives	**Contents**
Indentify the common plant diseases and insect damage in the field	Definition of plant diseases and insect damage Common plant diseases and their damage symptoms
Practical 24: Indigenous knowledge system on insect pest control	**Hrs :2**
Objectives	**Contents**
Describe about the indigenous knowledge system on insect pest control Explain the indigenous knowledge	Definition of indigenous knowledge Significance of indigenous knowledge on pest management Common indigenous knowledge practices of pest management
Practical 25: Indigenous knowledge system on plant diseases control	**Hrs :2**
Objectives	**Contents**
Describe about the indigenous knowledge system on plant diseases control Explain the indigenous knowledge	Definition of indigenous knowledge Significance of indigenous knowledge on diseases management Common indigenous knowledge practices of diseases management
Practical 26: Survey of eco-friendly plant protection measures	**Hrs :4**
Objectives	**Contents**

Documentation of eco-friendly plant protection measures	Development of short pre-structured questionnaires Field visit Collection of information about eco-friendly plant protection measures
Practical: 27 **Identification of commonly available insecticide and pesticide in lacal market.**	**Hrs 4**
Objectives	Contents
Vist local pesticide market and plant protection section of DADO. Enlist common pesticide available in local pesticide shops.	Aware about pesticide market. Categorisation of level of hazardness of available pesticide in local market.
Evaluation Methods: Oral and written test examination	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Note: All practical classes will be related to Intrigrated Pest Management Student Field School (IPM SFS) at school field.

Soil Management, Conservation and Environmental Science

Credit hours: 3+1 hours/week **Full Marks: 100**

Total hours: 160 hours

Theory: 96 hours

Practical: 64 hours

Course Description

This course provides basic knowledge in soil science**,** geology in relation to soil**,** Physical, chemical and biological properties of soil, sources, functions and deficiency symptoms of plant nutrients**,** Organic matters and their properties, Preparation of organic manures (FYM, compost, green manure), Biofertlizers and biogas, Composition, uses and behavior of Nitrogenous, Phosphatic , Potassic fertilizers in soil, Integrated nutrient management, Definition, Causes, Types of soil erosion by Water and Consequences of soil erosion in Nepal, Soil erosion control measures on Agriculture land, Forest and rangeland, Bio-engineering, Engineering control measures, Definition, scope and importance of environmental studies, introduction to natural resources: Forest, Water and land, Definition, causes, effects and control measures of Air pollution, Water pollution , Soil pollution, Water conservation, rain water harvesting, watershed management.

Course Objectives

This Course has the following Objectives:

Gain basic knowledge and skill on soil, soil fertility and soil conservation.
Understand functions and deficiency symptoms of nutrients for maximum yield of crops
Gain knowledge and skills on compost preparationfrom various sources of organic materials
Gain knowledge and skills on soil erosion and its control
Understand environmental problems and control measures

Minimum Standards

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

Text and Reference books

Brady, N.C. 1990. The Nature and Properties of Soils, 14th edit. Macmillan Publishing Co., NewYork

Miller, R.W. and R.L. Donahue. 1995. Soils: In Our Environment. Prentice Hall, New Jersey

Tisdale, S.L., W.L. Nelson and J.D. Beaton. 1990. Soil Fertility and Fertilizes, Macmillan Publishing Co., New York

Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)

Bharucha Erach, 2004, UGC Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)

Course: Soil Management, Conservation and Environmental Science	**Hrs. Theory : 96 Hrs. Practical : 64**
Unit: 1	**Hrs theory : 5**
Objectives	Contents
Introduction to course Define soil Define soil science terms and concept	Definition, concept and uses of soil Soil as a natural dynamic body and medium for plant growth Soil- plant relation
Evaluation Methods: Oral and written tests,	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration manuals, diagrams, visuals, textbooks, and reference books
Unit: 2	**Hrs theory : 5**
Objectives	Contents
Explain geology in relation earth formation to soil	Rock and minerals Weathering of rocks Physiographic units of Nepal in relation to soil Evolution of earth
Evaluation Methods: Oral and written tests,	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 3 Soil properties	**Hrs Theory: 22**

Objectives	Contents
Explain physical, chemical and biological characteristics of soil	Physical Soil texture Soil structure Bulk density, particle density, porosity and soil color Chemical Soil reaction: soil pH, soil acidity and liming Saline-sodic soils and their management Soil colloids: organic and inorganic, cation and anion exchange Biological Organic matters and their importance Soil flora and fauna Organic manures and their properties Preparation of organic manures (FYM, compost, green manure) Bio-fertilizers and biogas
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 4 Plant nutrition	**Hrs Theory: 20**
Objectives	Contents
Understand functions, deficiency symptoms of plant nutrients. Evaluate soil fertility for crop growth	• Essential plant nutrients 4..1 Primary 4..2 Secondary 4..3 Micronutrients • Sources of nutrients • Functions and deficiency symptoms • Soil fertility evaluation 4..1 Visual symptoms 4..2 Plant tissue analysis

	4..3 Biological methods 4..4 Soil tests
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 5. Fertilizers	**Hrs Theory: 12**
Objectives	Contents
Explain fertilizers composition and reaction in soil. Understand integrated nutrient management practices	6.1 Composition, uses and behavior in soil 6.1.1 Nitrogenous fertilizers 6.1.2 Phosphatic fertilizers 6.1.3 Potassic fertilizers 6.2 Integrated nutrient management 6.2.1 Concept and relevance 6.2.2 Components 6.2.3 Management option 6.2.4 Soil fertility problems in Nepal and their management
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 6 Soil conservation	**Hrs Theory: 16**
Objectives	Contents
Understand definition, causes, types and consequences of soil erosion in Nepal. Explain soil erosion control measures. To acquent with agricultural tools & machinaries and their functions.	7.1 Definition of soil erosion 7.2 Causes of soil erosion 7.3 Types of soil erosion by water 7.4 Consequences of soil erosion in Nepal 7.4.1 Fertility loss and land degradation 7.4.2 Flood, landslide and natural hazards

	7.4.3 On-site and off-site effects 7.4.4 Socio-economic effects 7.5 Soil erosion control measures 7.5.1 Agriculture land 7.5.1.1 Conservation tillage 7.5.1.2 Mulching 7.5.1.3 Terrace cropping 7.5.1.4 Contour farming 7.5.1.5 Strip or cover cropping 7.5.2 Forest and rangeland 7.5.2.1 Aforestation 7.5.2.2 Controlled grazing 7.5.3 Bio-engineering 7.5.4 Engineering 7.5.5 Use different equipments and machinaries • Power Tiller • Cultivator
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 7 nature of environmental studies	**Hrs Theory: 8**
Objectives	Contents
Define and understand scope and importance of environmental science Explain natural resources management and associated problems	Definition, scope and importance From Unsustainable to Sustainable development, organic farming Need for public awareness Forest resources : Use and over-exploitation, deforestation Water resources: Use and over-utilization of surface

	and ground water, floods, drought. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable development
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 8 Environmental Pollution	**Hrs Theory: 8**
Objectives	Contents
Explain causes, effects and control measures of environmental problems	Definition, types(major) Cause, effects and control measures of :- Air pollution Water pollution Soil pollution Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Water conservation, rain water harvesting, watershed management Climate change, global warming, acid rain, ozone layer depletion
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Soil Management, Conservation and Environmental Science Practicals

Soil Management, Conservation and Environmental Science Practical	**Hrs Practical : 64 hours**
Practical 1: Study of paddy and upland soil profiles	**Hrs : 2 hours**
Objectives	Contents
Familiarize with profile description technique Identify different horizons on morphological basis Understand the effect of drainage differences on land use and soil management.	Definition and importance of soil profile Study soil profile in lowland and upland
Practical 2: Collection and preparation of soil samples	**Hrs : 2 hours**
Objectives	Contents
Understand soil sampling procedure and preparation techniques Obtain representative soil sample for soil testing	Definition and importance of soil and plant sampling Selection of sampling area within field Soil and plant sampling - field techniques
Practical 3: Determination of soil texture by feel method and Hydrometer method	**Hrs : 4 hours**
Objectives	Contents
Familiarize with soil textural classes Determine soil texture by feeling with hands.	Definition, importance of soil texture Procedure – textural determination
Practical 4: : Determination of soil consistence by feel methods	**Hrs : 2 hours**
Objectives	Contents
Determine dry, moist and wet consistency	Definition, importance of soil consistence Determination procedure
Practical 5: Identification of major soil forming rocks and minerals	**Hrs : 2 hours**
Objectives	Contents
Identify common rocks and minerals found in Nepal	Definition of rocks and minerals Criteria for identification of rocks and minerals Description of selected rocks and minerals

Practical 6: Determination of bulk density and particle density	**Hrs : 2 hours**
Objectives	Contents
Determine bulk density of soil Perform bulk density related calculations Understand soil texture and structure relations with bulk density	Definition of bulk density of soil Relation of bulk density to texture and structure of soil Lab – procedure to determine BD of soil
Practical 7: Use of kit box for different analysis of soil	**Hrs : 4 hours**
Objectives	Contents
Determine soil pH in field Estimate available nitrogen, Phosphorus and Potassium in soil in field	Procedure – for determination of soil pH, available N, P, K in soil in field using kit box Interpretation of soil test results
Practical 8: Identify different manures and chemical fertilizers	**Hrs : 2 hours**
Objectives	Contents
To acquaint with the fertilizers and manures and with their contents To have visual identification of different chemical fertilizers and manures	Classification of fertilizers, composition Classification of organic manures and nutrient composition. Calculation for fertilizer requirements
Practical 9: : Collection and identification of nutrient deficiency symptoms of major plants	**Hrs : 4 hours**
Objectives	Contents
Identify and compare nutrient deficiency symptoms of major plants	Describe any abnormal symptoms in plants. Identify nutrient deficiency of plant nutrients
Practical 10: Determination of organic matter of soil	**Hrs : 4 hours**
Objectives	Contents
Determine organic carbon content of soil	Importance of organic carbon in soil Procedure and calculation to determine the organic carbon in soil

Practical 11: Visit to observe soil profiles and eroded soils	**Hrs : 4 hours**
Objectives	Contents
Estimate soil erosion of an area.	Visit the eroded site To assess soil erosion based on observation of site characteristics
Practical 12: Visit to a local area to document environmental assets- river/forest/grassland/hill/mountain	**Hrs : 8 hours**
Objectives	Contents
To identify and document: What are the ecosystems goods and services? (checklist of resources) Who uses them and how? Is the utilization sustainable or unsustainable (sign of degradation) How can the ecosystem be used sustainably?	Observation of the ecosystems Questioning local people on the use of resources and sustainability Discussion: Observations on levels of resource use found during the field work Findings: specific concerns relevant to the study site's sustainable utilization as discussed with local people Results and discussion
Practical 13: Visit to a local polluted site- Urban/Rural/Industrial/Agricultural/ Visit to industry to observe technology of solid waste management	**Hrs : 8 hours**
Objectives	Contents
Study cause and effect of pollution at the site Visit to observe technology of solid wastemnagement	What is the site? Observation at the polluted site What are reasons for pollution? Categorization of waste What action can you take to reduce pollution?

Practical 16: Study of simple ecosystems-pond, river, hill slopes(related flora and fauna)	**Hrs : 4 hours**
Objectives	Contents
Describe and document biotic and a biotic component of an ecosystem.	What is the site? Observation of biotic and a-biotic component. Are its goods and services used or misused? How this degradation process can be prevented?
Practical 17: Identification of agricultural tools & materials and their maintenance	Hrs : 4 hours
Objectives	Contents
Identify agricultural tools & materials Maintenance agricultural tools & equipment	Description of the parts and functions of power tiller, thressor and cultivator.

Postharvest Technology

Credit hours : 1+2/week **Full Marks: 50**

Total hours: 96 hours

Theory: 32 hours

Practical: 64 hours

Course Description

This course will provide knowledge about the physiology of harvested fruits, vegetables and ornamentals. The students will be able to understand major physiological activities and biological changes that reduce the postharvest life of fresh products. Various factors that affect shelf life of the produce will be described. Basic methods of primary processing such as grading, sorting, cleaning, de-handing, trimming, packaging and storage will be practiced. Principle and practices of processing and preservation will be taught. Home level processing and preservation of fruits, vegetables and juices will be practiced.

Course Objectives

- This Course has the following Objectives:

To acquaint with the changes in horticultural produce i.e., fruits vegetables and cut flowers after harvest.
To acquaint knowledge about how to minimize postharvest loss of horticulture produce during harvesting, handling and marketing
Upon the completion of course the students will be able to harvest crop at appropriate stage of maturity and handle (sorting, trimming, grading, packaging, transportation etc.) carefully to extend their shelf life.
The students will be able to prepare various products such as Jam, Jelly, Marmalade, Juice, Ketchup, Juice, pickles and dried products.

Minimum Standards

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

Text and Reference books

Gautam D.M and D.R. Bhattarai. 2012. Postharvest Horticulture, New Plaza, Kathmandu, Nepal.
Bautista, O.K, 1990. Postharvest Technology of Southeast Asian Perishable Crops. Technology and Livelihood Resource Center, Philippines.

Kader, A.A 2002. Postharvest Technology of Horticultural Crops, University of California Agriculture and Natural Resources Publications

Pandey, P.H. 1997. Postharvest Technology of Fruits and Vegetables. Saroj Prakashan, Allahabad, India

Gustavo, V. B. 2003. Handling and Preservation of Fruits and Vegetables by Combined Method for Rural Areas. Technical Manual Issue 149, Food and Agriculture Organization

Course: Post Harvest Technology	**Hrs. Theory : 32 Hrs. Practical : 64**
Unit: 1 Scope and Importance of postharvest technology	**Hrs theory : 6**
Objectives	Contents
Explain scope and Importance of postharvest technology	History of postharvest technology Primary and secondary processing Scope and Importance of postharvest technology
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 2 physical and chemical changes of horticulture product	**Hrs theory : 8**
Objectives	Contents
Explain post harvest physiology of horticultural produce Discuss factors affecting postharvest loss	Basic difference in attach and detach organ Define and Explain Respiration Types of respiration How respiration affects shelf life Define transpiration and explain how transpiration affects postharvest shelf-life Ethylene production and its effect on Post harvest self life Other physic chemical changes Ripening of the fruits
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Unit: 3 Maturity judgment and harvesting	**Hrs Theory 6**
Objectives	Contents
Explain maturity judgment and harvesting method. Explain role of sorting, cleaning, trimming, washing, grading. Explain the types of harvesting	Harvesting, handling, packing house operations and various postharvest practices Appropriate time of harvesting or Maturity indices of different fruits and vegetables Fungicide treatment, smoking, sulphuring Packaging and transportation Commercial harvesting
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 4 Factors affecting storage	**Hrs Theory 6**
Objectives	Contents
Describe commodity factor and environmental factors Describe methods of storage	Factors: temperature, relative humidity, gases and pre-cooling of the produce. Principles and methods of storage Methods of storage; cold storage, modified atmosphere storage, controlled atmosphere storage, cellar storage and rustic storage
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 5 Processing and preservation of fruits and vegetables	**Hrs Theory 6**
Objectives	Contents
Discuss about principal and practics of preservation of fruit, vegetable and fresh flower. Explain the types of presevation	Histry, principal and practics of preservation. Practics of canning and bottling. Heat treatment and Pasturazion. Preservation by addition of sugar, salt and other preservatives.

	Addition of color and flavour
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Practicals

Post Harvest Technology **Practical**	**Hrs Practical : 64**
Practical 1: Identification of laboratory equipments, tools and chemicals .	**Hrs : 4**
Objectives	Contents
Identify laboratory equipment, tools and chemical .	To identify equipements, tools, utensils, preservative chemical, refractometer, thermo hygrograph, psychrometer, penetrometer, salino meter, gel meter, titrating equipments. etc
Practical 2: Monitoring of temperature and relative humidity	**Hrs : 4**
Objectives	Contents
Monitor temperature and relative humidity	Monitor minimum- maximum temperature, determination of relative humidity through psychrometric chart.
Practical 3: Maturity Judgement	**Hrs : 6**
Objectives	Contents
Perform maturity Judgement	Field visit to judge maturity of vegetables and fruits. Use of different criteria to judge maturity ex; visual, chemical, physical etc.use of penetrometer and other instrument to judge maturity
Practical 4: Harvesting and Grading	**Hrs : 4**

Objectives	Contents
Perform harvesting and grading	Harvesting of fruit, vegetables Cleaning, sorting, and grading
Practical 5: Harvesting and market preparation of cut flowers	**Hrs : 4**
Objectives	Contents
Harvest and market cut flowers	Harvesting of cut flowers, trimming, sugar pulsing and chemical treatments
Practical 6: Packaging	**Hrs : 4**
Objectives	Contents
Perform Packaging	Specific packaging of fruits, vegetables and flowers for the local and distant markets.
Practical 7: Drying and dehydration	**Hrs : 8**
Objectives	Contents
Dry and dehydrate the vegetables.	Drying of vegetables such as cabbage, beans. Preparation potato chips
Practical 8: Preparation of juice and sqashes	**Hrs : 4**
Objectives	Contents
Prepare juice and sqashes	Preparation of orange or any other fruit juice, processing and bottling
Practical 9: Preparation of Jam, Jelly or marmalade	**Hrs : 6**
Objectives	Contents
Prepare of Jam, Jelly or marmalade	Preparation of jam , jelly or marmalade from seasonal fruits
Practical 10: Preparation of candy and murabba	**Hrs : 8**
Objectives	Contents
Prepare candy and murabba	Preparation of candy Preparation of murabba

Practical 11: Preparation of pickle and sauces	**Hrs : 8**
Objectives	Contents
Prepare pickle and sauces	Preparation of pickle Preparation of tomato sauce or ketchup.
Practical 12: Organoleptic taste and hedonic rating to judge quality	**Hrs : 4**
Objectives	Contents
Perform organoleptic taste and hedonic rating to judge quality	Organoleotic test of preserved or processed product Hedonic rating of fresh fruit and vegetables

Third Year

1. Commercial Vegetable Production
2. Medicinal and Non Timber Forest Product
3. Crop Production
4. Plant Breeding and Seed Production Technology
5. Industrial Entomology and Mushroom Cultivation
6. Ornamental Horticulture and Nursery Management
7. Fruits and Plantation Crops
8. Work Experience Program (WEP)

Commercial Vegetable Production

Credit hours: 2+1/week **Full Marks: 100**

Total hours: 128 hours

Theory:. 64 hours

Practical: . 64 hours

Course Description

This course provides basic knowledge and practices in commercial vegetable production including introduction to horticulture, its branches, olericulture and its related terminologies; importance and scope of commercial vegetable production; types of vegetable farming; edaphic and climatic factors; cultural practices of commercial vegetable and spice crops with respect to origin, area, production, varieties, climate and soil, sowing, nursery raising, transplanting, field preparation, manuring, fertilization, irrigation, intercultural practices, insect pest and disease management, harvesting, postharvest handling, processing, marketing and economy of production of the crops : solanaceous fruit vegetables (tomato, chillies, sweet pepper, and eggplant); cole crops (cauliflower, cabbage and broccoli); cucurbits (cucumber, bitter, pointed and bottle gourds and watermelons) ; tuber and bulb crops (potato, onion and garlic) ; leafy vegetables (spinach, lettuce, broad leaf mustard, cress and swisschard ; root crops (carrot and radish); legume crops (beans and peas); asparagus and okra; and spice crops (ginger, turmeric and coriander). In addition to these, this course covers off-season vegetable production techniques, principles and practices of seed production and seed production techniques of the crops potato, radish, carrot, beans, peas, tomato, cauliflower, cabbage, cucumber and onion.

Course Objectives

- This Course has the following Objectives:

Explain the basic principles of commercial vegetable production.

Describe the production techniques of major vegetable crops.

Demonstrate off-season production techniques and kitchen gardening.

Explain principles and practices of seed production of major vegetable crops.

Apply technical skills in main season and off-season fresh vegetable production and seed production.

Minimum Standards

Students must achieve the minimum 40% marks in theory and 60% marks in practical.

Text books and References

Anonymous. 2046 B S. Nepalma Tarkari Kheti (3rd ed), Vegetable Development

Division, DOA, HMG/Nepal, Khumaltar

Pun, L. and B. B. Karmacharya. 1998. Trainer's manual-Vegetables. Department of Agriculture, Agric. Manpower Development and Training Program, Kathmandu

Arya, P. S. 1999. V getable Seed Production: Principles, Kalyani Publishers

Bose, T.K. M.G. Som and J. Kabir. 1993. Vegetable Crops, Naya Prakash, Culcuta

Anonymous. 1990. Vegetable Production Training Manual. Asian Vegetable Research and Development Center, Tainan, Taiwan

Rana, M. K . 2008. Scientific Cultivation of Vegetables. Kalyan Publishers, India.

Rana, M. K. 2008. Olericulture in India. Kalyani Publishers, India.

Anonymous. 2068 B.S. Vegetable Farming Technology. GON, MOAC, Agribusiness Promotion and Statistics division, Singhdurbar, Kathmandu, Nepal and Asian Food and Agriculture Initiative.

Theory course description

Course: Commercial Vegetable Production	**Hrs. Theory : 64 Hrs. Practical : 64**
Unit: 1. Introduction	**Hrs theory : 3**
Objectives	Contents
Define horticulture, its branches and olericulture Explain importance and classification of vegetables	Definition /scope/importance of olericulture and its branches and importance Common terms and classification of vegetable crops
Evaluation Methods: Oral, written tests and Assignment	Teaching /Learning activities and resources: Class room instruction, diagrams, visuals and reference book
Unit: 2 Vegetable farming	Hrs theory : 4
Objectives	Contents
Classify vegetable farming and describe them briefly	Types of vegetable farming, their definition and description, importance, crop selection for each type, site selection and calendar of vegetable production for year round supply.

Evaluation Methods: Oral and written tests and assignment	**Teaching /Learning activities and resources:** Classroom instruction, observations, illustration, visuals and reference books
Unit: 3. Soil and climatic factors	**Hrs Theory: 2**
Objectives	Contents
Describe soils factors influencing commercial vegetable production Explain climatic factors and climate change Affecting commercial vegetable production	Soil factors and their effects on vegetable production Climatic factors and their effects on vegetable production
Evaluation Methods: Oral and written tests and assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observations, visuals and reference book
Unit: 4 Cultivation practices of vegetable and spice crops	**Hrs theory : 30**
Objectives	Contents
Describe the commercial production techniques of the following crops: 1.Solanaceous fruit vegetable crops-tomato, chilies, sweet pepper and eggplant 2. Cole crops- cauliflower, cabbage and broccoli 3. Cucurbitaceous crops- cucumber, sponge, bitter, pointed and bottle gourds and watermelon 4. Tuber and bulb crops - potato, onion and garlic 5. Leafy vegetable crops- spinach, lettuce, broad leaf mustard, cress and swisschard 6. Root crops- carrot and radish 7. Legume crops- beans, peas and cowpeas 8. Asparagus and okra	Describe each of the listed crops with respect to origin, importance, area, production, trade, soil and climatic requirements, varieties, sowing/ nursery raising and transplanting, field preparation, manuring, fertilization, general and crop or season specific intercultural practices, irrigation, side dressing, integrated insect pest and disease management, harvesting, postharvest handling, processing,storage , marketing and economy of production. Explain present situation and scope of mechanization of commercial vegetable production.

9. Spice crops- ginger, turmeric and coriander	
Evaluation Methods: Oral, written tests and Assignment	**Teaching /Learning activities and resources**: Class room instruction, diagrams, observation, diagrams, visuals and text and reference books
Unit: 5 Off-season vegetable production	**Hrs theory : 3**
Objectives	Contents
1. Define off-season and describe opportunities and problems. 2. Describe the potential off-season crops for each agro ecological belt. 3. Describe the off-season vegetable production techniques and crop protection measures	Introduction , opportunities and problems Off-season production techniques- potential crops for off-season, comparative advantages of different agro ecological belts, hotbed, plastic mulching, low, use of PGR, medium and high tunnels, plastic house, crop, insect pest and disease management
Evaluation Methods: Oral and written tests and assignment	**Teaching /Learning activities and resources:** Classroom instruction, observations, illustration, visuals and reference books
Unit: 6. Vegetable seed production	**Hrs Theory: 22**
Objectives	**Contents**
Describe the importance and status of vegetable production in Nepal Classify vegetables based on pollination behavior. Explain variety maintenance, seed multiplication and hybrid Seed production techniques. Describe seed production techniques of the major vegetable crops.	Importance, status, pollination behavior of vegetable crops, variety maintenance, seed multiplication and hybrid seed production methods and improved seed production techniques of the crops- potato, radish, carrot, bean, peas, cauliflower, cabbage, tomato, cucumber and onion.

Describe the importance and status of vegetable production in Nepal Classify vegetables based on pollination behavior. Explain variety maintenance, seed multiplication and hybrid Seed production techniques. Describe seed production techniques of the major vegetable crops.	Importance, status, pollination behavior of vegetable crops, variety maintenance, seed multiplication and hybrid seed production methods and improved seed production techniques of the crops- potato, radish, carrot, bean, peas, cauliflower, cabbage, tomato, cucumber and onion.
Evaluation methods: Oral and written tests and assignment	**Teaching/learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text and reference books

Practical course description of Commercial Vegetable Production

Practical	**Hrs Practical : 64**
Practical 1: Identify vegetable crops and their seeds.	**Hrs : 2**
Objectives	Contents
Identify vegetable crop plants, edible parts and seeds. Record their morphological characters.	Morphology of crop plants, edible parts and seeds
Practical 2: Identify spice crops and their seeds.	**Hrs : 2**
Objectives	**Contents**
Identify the spice crop plants and their edible parts and seeds. Record the morphology of crop plants, edible parts and seeds.	Morphology of crop plants, edible parts and seeds
Practical 3: Determine germination and other quality tests of vegetable seeds.	**Hrs : 4**
Objectives	**Contents**
Determine seed purity and moisture.	Seed quality parameters: purity, moisture

Evaluate seed vigor and germination.	Vigor and germination
Practical 4: Raising vegetable seedlings.	**Hrs : 8**
Objectives	**Contents**
Prepare nursery bed. Sow the seeds. Care of the seedlings.	Site selection, layout, bed preparation, manuring, fertilization, soil treatment, sowing, mulching and irrigation
Practical 5: Field preparation for sowing/ transplanting	**Hrs : 4**
Objectives	**Contents**
Prepare the field. Manure and fertilize. Sow seeds or transplant seedlings.	Ploughing, clodding, removing weeds stones and crop residues, manuring, fertilization, sowing or transplanting.
Practical 6: Kitchen gardening	**Hrs : 4**
Objectives	**Contents**
Site selection and layout. Prepare the plots. Select the proper crops. Sow seeds or transplant the seedlings.	Site selection, design, layout, field and plot preparation, crop selection and sow seeds or transplanting seedlings.
Practical 7: Prepare hotbed and different tunnels or plastic house.	**Hrs : 4**
Objectives	**Contents**
Prepare hotbed. Prepare different tunnels or plastic house Grow seedlings in plastic pot Care of the seedlings	Pit digging, filling up the pit, making plastic tunnel over hotbed, and sowing seeds in plastic pots or plastic tunnel or house for raising seedlings.
Practical 8: Side dressing and irrigation methods.	**Hrs: 4**
Objectives	**Contents**
Calculate the recommended dose of fertilizers(NPK) Select the proper method of application of fertilizer	

Side dresses the crop. Select proper method of irrigation and irrigate.	Fertilizers' dose, methods of side dressing, methods of irrigation
Practical 9: Operate intercultural practices	**Hrs: 4**
Objectives	**Contents**
Operate general and crop specific intercultural practices.	Weeding, hoeing, mulching, staking, earthing up, training, pruning, blanching, removing old and diseased leaves, abnormal plants and fruits.
Practical 10: Identify major insect pests and their nature of damage.	**Hrs: 4**
Objectives	**Contents**
Identify the major insect pests of the commercial vegetable crops. Describe their morphology and their nature of damage.	Introduction to the major insect pests, their nature of damage
Practical 11: Identify majorpest, diseases and their symptoms.	**Hrs: 4**
Objectives	**Contents**
Identify the major diseases of the vegetable crops and record their initial and severe symptoms.	Causal agents, initial symptoms, advanced symptoms and conductive conditions.
Practical 12: Apply integrated pest and disease management measures.	**Hrs : 4**
Objectives	**Contents**
Describe integrated methods of insect pest management and apply them. Describe integrated methods of disease management and apply them	Integrated methods of insect pests and disease management
Practical 13: Maturity indices and methods of harvest.	**Hrs: 4**
Objectives	Contents

1. Observe the maturity indices in major vegetable and spice crops and record them. 2. Apply proper harvest method for the given crop.	Appropriate harvesting stages in vegetable crops for commercial harvest, methods of harvest and proper method for commercial crops.
Practical 14: Post harvest handling and marketing of vegetable and spice crops.	**Hrs : 4**
Objectives	Contents
Apply the postharvest practices in the given vegetable crop groups. Record the crop wise differences in postharvest practices.	Postharvest cleaning, trimming, cooling, precooling , grading, packaging, transportation, storage, Market channels and facilities.
Practical 15: Visit to vegetable farm and wholesale market.	**Hrs :4**
Objectives	Contents
Record the vegetable farm resources and programs Wholesale market facilities, day/month/annual supply and distribution.	Vegetable farm size, layout, design, production program, market facilities, supply and distribution

Medicinal Plant and Non timber Forest Product

Credit hours: 2+1/week **Full Marks:100**

Total hours: 128 hours

Theory: 64 hours

Practical: 64bhours

Course Description

This course will provide knowledge about the importance and values of medicinal, aromatic plants and other non-timber forest products. Existing situation in Nepal and scope. Identify important medicinal plants, their uses, climate and soil requirement, propagation techniques and practices. Sustainable management in the natural system and domestication of production.

Course Objectives

This Course has the following Objectives:

Acquaint with the scope and importance of medicinal and non-timber forest product in Nepal.

Identify important medicinal plants and non-timber forest product and their production area.

Practice propagation techniques for multiplication .....

Domestication and cultivation practices of important medicinal plants and non-timber forest product

Minimum Standards

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

Text and Reference books

Atal, C.K and B.M. Kapur (eds). 1982. Cultivation and utilization of medicinal and aromatic plants. Regional Research Laboratory, CSIR, Jammu-Tawi, India.

Bhattarai, K.R. and M.D. Ghimire. 2006. Cultivation and sustainable harvesting of commercially important medicinal and aromatic plants of Nepal. Heritage Research and Development Forum, Nepal P. 394

Bhattacharjeee, S.K. 2000. Handbook of aromatic plants. Pointer Publisher, Jaipur, India.

IUCN, Nepal. 2000. National Register of aromatic plants. IUCN- Nepal, Kathmandu

Kaufman, P.B., L.J.Ceske, S. Werber, J.A. Duke and H.L. Brielmann. 1999. Natural Products from plants. CRC Press, USA.

Course: Medicinal and Non timber Forest Product	**Hrs. Theory: 64 Hrs. Practical :64**
Unit: 1 Role of medicinal plants and non-timber forest products	**Hrs theory : 4**
Objectives	Contents
Describe scope and importance of medicinal plants and non-timber forest products	Definition of medicinal plants and non-timber forest products Major constraints in the promotion of medicinal plants and non-timber forest products. National and international trade
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 2 Classification of medicinal and aromatic plants and non-timber forest products.	**Hrs theory : 6**
Objectives	Contents
Classify medicinal and aromatic plants and non-timber forest products.	Classification according to use, growth habit, morphology, climatic requirements and parts of the plant used.
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 3 Cultivation practices of medicinal plants and non-timber forest products and species	**Hrs Theory 24**
Objectives	Contents
Describe cultivation practices of medicinal plants and non-timber forest products and species.	Plant profile, description, origin, distribution cultivation, harvesting, processing and uses of different medicinal plants(traditional use also)

Explain processing and uses of different species.	Description of botany ,distribution cultivation practices, processing and uses of following species Ader, Alaichi, Aloevera, Amala, Ashuro, Ashwagandha, Atis, Babari, Bail, Beladona, Bikha, Biubidanga, Bojho, Chiraito, Chitu, Citronela, Guchchhichyau, Gurjo, Indra jau, Indrayani, Jatamasi, Kakarsingh, Kalmegh, Kalo Musali, Kauso, Keshar, Kukti, Kurilo, Kyamomila, Lauthsalla, Lemon grass, Mentha, Nisoth, Okhar, Padamchal, Pakhanbet, Pamarosa, Pipermint, Pipla, Ritha, Safed Musali, Sarpagandha,, Satuwa, Sikakai, Sugandhakokila, Sugandhawal, Tarul, Githa, Timur, Yarchagumba, Zinger,
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books, presentation
Unit: 4 Harvesting, packaging and storage of medicinal plants and non-timber forest products.	**Hrs Theory 10**
Objectives	Contents
Explain Harvesting, Drying, Dehydration, Packaging and storage	Maturity stage and methods of harvesting, sorting, grading, drying and dehydration, packaging, storage.
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration,

	diagrams, visuals, textbooks, and reference books, presentation
Unit: 5 Processing and preservation of medicinal plants and non-timber forest products.	**Hrs Theory 10**
Objectives	Contents
Discuss on processing and preservation	Processing and preservation such as oil and alkaloids extraction and it preservation and bottling.
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books
Unit: 6 Market and marketing of medicinal plants and non-timber forest products.	**Hrs Theory 10**
Objectives	Contents
Determine market and marketing	National and international market. Different channels of marketing. Record and Record Keeping. Value chain.
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Practicals

Medicinal and Non timber Forest Product Practical	**Hrs Practical : 64 hrs**
Practical 1: Identify tools, equipment and materials.	**Hrs : 2**

Objectives	Contents
Identify equipment, tools, utensils, preservative chemical	Identification of laboratory equipment, tools and chemicals.
Practical 2: Identify locally available medicinal, aromatic and non-timber forest plants.	**Hrs : 10**
Objectives	Contents
Conduct field visit to identify different medicinal, aromatic and non-timber forest plants.	Identification of medicinal, aromatic plants and other non-timber forest
Practical 3: Propagate medicinal, aromatic and non-timber forest plants.	**Hrs : 6**
Objectives	Contents
Perform Nursery preparation and sowing of seeds and plants	Nursery preparation and sowing of seed and plants
Practical 4: Cultivate medicinal plants and non-timber forest products.	**Hrs : 28**
Objectives	Contents
Perform asexual propagation of various medicinal and aromatic plants; tissue culture for important MAP.	Propagation of grasses and herbs type plants, Shrub type plants and tree type plants. Different methods and technology of propagation such as separation, cutting, layering and grafting, bucking and chemical treatments will be practiced in several consecutive practical classes.
Practical 5: Harvest medicinal plants and non-timber forest products.	**Hrs : 6**
Objectives	Contents
Perform harvesting and market preparation Perform herbarium preparation of MAP	Harvesting of medicinal, aromatic plants and

	Fruit, extraction of seed, harvesting of bark, leaves and foliage, underground parts and whole plants.
Practical 6: Process medicinal, aromatic and non-timber forest plants after harvesting.	**Hrs : 4**
Objectives	Contents
Perform drying and dehydration	Perform drying or dehydration of harvested products
Practical 7: Prepare for Marketing of medicinal, aromatic and non-timber forest plants.	**Hrs : 4**
Objectives	Contents
Perform packaging, storage and marketing	Packaging, storage and marketing of medicinal, aromatic and non-timber forest plants.
Practical 8: Perform extraction of oil from aromatic plants.	**Hrs : 4**
Objectives	Contents
Perform extraction of oil from aromatic plants'	visit of oil Extraction or processing plant

Crop Production

Credit hours: : (3+1)/week **Full Marks:100**

Total hours: 160 hours

Theory: 96 hours

Practical: 64 hours

Course Description

This course provides the theoretical as well as practical knowledge to the students in crop production of cereal crops such as rice, wheat, maize, finger millet, buckwheat and barley; oil seed crops such as rapeseed and mustard, groundnut, sunflower, safflower, sesamum, linseed and niger; grain legume crops such as lentil, soybean, pigeon pea, chick pea, cowpea, black gram and green gram; industrial crops such as sugarcane, cotton, tobacco, jute and tea with respect to the topics importance and uses, distribution, area of production, origin, botany, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, yield, processing, economic profit and storage including the definition, importance and scope of agriculture, geological distribution of cash crops and industrial crops in Nepal.

Course Objectives

This Course has the following Objectives:

Identify the cereal crops, oilseed crops, grain legume crops and industrial crops in respect to the geographical distribution in Nepal and in the world.

Explain the uses and importance of cereal crops, oilseed crops, grain legume crops and industrial crops in Nepal and in the world.

Classify the botany of crops appropriately and determine the origin place of each crop.

Identify the seeds of different cereal crops, oilseed crops, grain legume crops and industrial crops properly.

Explain about the cultivation practices of cereal crops, grain legume crops, oil seed crops and industrial crops including the control measures of insect pests and diseases.

Minimum standards

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

Text and Reference books

1. Scientific Crop Production in India, Ahalawat, I.P.S, Om Prakash and G.S. Saini
2. Techniques of Raising Field Crops, Rathore, P.S.
3. Modern Techniques of Raising Field Crops, Singh, C.
4. Crop Management Under Irrigated and Rainfed Conditions, Singh, S.S.
5. An Introduction to Agronomy (in Nepali language), Bhattachan, B.K. and Devekota, K.H.
6. Annual Report of National Rice Research Program, Hardinath, Janakpur, National Maize Research Program Rampur Chitwan, National Wheat Research Program Bhairahawa, National Grain Legume Research Program Rampur Chitwan, Nepal Oilseed Research Program Nawalpur Sarlahi, National Sugarcane Research Program Jitpur, National Tobacco Research Program Janakpur, National Cotton Research Program Nepalganja, National Jute Research Program Belachapi and Tea Production Company Illam Nepal.

Course: Crop Production	**Hrs. Theory: 96 Hrs. Practical:64**
Unit 1: Introduction of Cereal, Oilseed, Grain Legume and Industrial Crops	**Hrs theory: 5**
Objectives	Contents
Define subsistence and commercial agriculture, cash and industrial crops Discuss about the geographical distribution, importance and scope of cash and industrial crops	Definition of subsistence and commercial agriculture Definition of cash crops and industrial crops Importance and scope of cash crops and industrial crops Geographical distribution of cash crops and industrial crops in Nepal Economic importance and scope of cereals and legume crops in the context of Nepal
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: Cultivation practices of rice and wheat	**Hrs theory: 15**
Objectives	Contents
Explain the cultivation practices of rice and wheat	Cultivation practices of rice and wheat on the headings such as uses, distribution, area of production,productivity(in different countries and in Nepal), origin, botany, climate, soil, varieties, land preparation, crop rotation, manure and fertilizers, seed treatment, raising seedlings, transplanting ,time and method of sowing seed, irrigation, weeding, insect pest management, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
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: Cultivation practices of maize and finger millet	**Hrs theory: 10**
Objectives	Contents
Explain the cultivation practices of maize and finger millet	Cultivation practices maize and finger millet on the headings such as uses, distribution, area of production, productivity(in different countries and in Nepal), origin, botany,phonological stages, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of

	sowing, irrigation, weeding, insect pest, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
Evaluation Methods: Oral and written tests, assignments	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit 4: Cultivation practices of buckwheat and barley	**Hrs theory: 6**
Objectives	Contents
Explain the cultivation practices of buck wheat and barley.	Cultivation practices of buck wheat and barley on the headings such as uses, distribution, area of production, origin, botany, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, yield, threshing, cleaning, economic benefit and storage.
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: Cultivation practices of rapeseed and mustard, sunflower, safflower and linseed	**Hrs theory:10**
Objectives	Contents
Explain the cultivation practices of rapeseed and mustard, sunflower, safflower and linseed	Cultivation practices of rapeseed and mustard, sunflower, safflower and linseed on the headings such as uses,

	distribution, area of production, origin, botany, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
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: Cultivation practices of groundnut, sesame and niger	**Hrs theory: 8**
Objectives	Contents
Explain the cultivation practices of groundnut, sesame and niger.	Cultivation practices of groundnut, sesame and niger on the headings such as uses, distribution, area of production, origin, botany, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
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: Cultivation practices of lentil, soybean and pigeon pea	**Hrs theory: 9**

Objectives	Contents
Explain the cultivation practices of lentil, soybean and pigeon pea.	Cultivation practices of lentil, soybean and pigeon pea on the headings such as uses, distribution, area of production, origin, botany, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
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 8: Cultivation practices of chick pea, cowpea, black gram and green gram	**Hrs theory: 10**
Objectives	Contents
Explain the cultivation practices of chick pea, cowpea, black gram and green gram**.**	Cultivation practices of chick pea, cowpea, black gram and green gram on the headings such as uses, distribution, area of production, origin, botany, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
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 9: Cultivation practices of sugarcane, cotton and tobacco	**Hrs theory:13**
Objectives	Contents
Explain the cultivation practices of sugarcane, cotton and tobacco.	Cultivation practices of sugarcane, cotton and tobacco on the headings such as uses,economic importances, distribution, area of production, productivity, origin, botany,phenology, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest, disease, harvesting, threshing, cleaning, yield, economic benefit and storage.
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 10: Cultivation practices of jute and tea	**Hrs theory: 10**
Objectives	Contents
Explain the cultivation practices of jute and tea.	Cultivation practices of jute and tea on the headings such as uses, economic importances, distribution, area of production, origin, botany,phenology, climate, soil, varieties, land preparation, manure and fertilizers, seed treatment, time and method of sowing, irrigation, weeding, insect pest,

	disease, harvesting, economic benefit and storage.
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.

Crop Production Practical

Crop Production Practical	**Hrs Practical: 64**
Practical 1: Identification of different field crops and seeds	**Hrs: 6**
Objectives	Contents
Identify and different field crops Collect different crops seeds.	Identification and collection of different cereal, oilseed crops, grain legume crops and industrial crops and seeds.
Practical 2: Fertilizer calculation and their applications	**Hrs: 6**
Objectives	Contents
Identify the different fertilizers Calculate the fertilizer doses for the crops Apply different fertilizers for different crops properly	Identification, calculation and application of fertilizers for different field crops properly.
Practical 3: Weed collection, identification and manual control measure.	**Hrs: 10**
Objectives	Contents

Identify different weeds grown with field crops. Collect and preserve different weeds grown with field crops. Remove the weeds grown with main crops.	Identification, collection, preservation and manual weeding of the weeds grown with different field crops.
Practical 4: Identification and application of insecticides, fungicides and herbicides for different field crops	**Hrs: 12**
Objectives	Contents
Identify the insecticides, fungicides and herbicides used in different field crops. Apply different concentrations of insecticides, fungicides and herbicides to control insects, fungus diseases and weeds observed in the field.	Identification, calculation of doses and application of different insecticides, fungicides and herbicides in the field.
Practical 5: Field preparation, planting, harvesting, threshing, cleaning and storage of major field crops	**Hrs: 30**
Objectives	Contents
Prepare field for seed sowing. Sow the seeds in the field. Harvest the matured crops in the field. Thresh, clean and store the field crops appropriately.	Field preparation, sowing of seeds, identify the maturity of crops, harvest, thresh, clean and store different field crops appropriately.

Plant Breeding and Seed Production Technology

Credit hours.: (3+1)/week **Full Marks.: 100**

Total Hours: 160

Theory: 96 hours

Practical: 64 hours

Course Description:

Basic concept of plant breeding; Domestication, Germplasm conservation and Plant introduction; Pollination and Reproduction in crop plants; Hybridization, Heterosis and Inbreeding depression; Breeding Methods; Mutation and Polyploidy; Basic concepts of seed technology, seed and quality seeds; Seed growth, dormancy, germination, vigour and longevity; Principles of seed production; Types of varieties and seed production schemes; Influence of seed quality on crop establishment, growth and yield; Foundation and certified seed production; Seed drying, cleaning, upgrading, testing, certification, legislation and intellectual property rights.

Course Objectives:

This course has following objectives:

Know the basic concepts of plant breeding and seed technology

Achieve importance and purpose of domestication, germplasm collection, conservation and plant introduction

Acquire knowledge of fundamentals principles and concepts of reproduction, pollination, hybridization, mutation and polyploidy

Gain basic knowledge of seed and its physiology, quality seeds and improved seeds

Describe basic breeding methods of different crops

Achieve basic seed production principles and skills of different crops

Describe seed processing, seed testing, seed certification, legislation and intellectual property rights

Observe seed processing plant, seed testing laboratory and seed production farms of respective organizations

Apply technical knowledge and skills in seed production, seed testing and hybridization

Minimum Standards:

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

Text and Reference books:

Agrawal, R. L., 2005. Seed Technology. Oxford and IBH Publishing CO. PVT. LTD. New Delhi. India.
Barsa, A. S., (Ed) 2002. Seed Quality: Basic Mechanisms and Agricultural Implications. CBS Publishers and Distributors. The Haworth Press. Inc., USA.
Chopra, V.L., 2000. Plant Breeding: Theory and Practices (2nd Ed.). Baba Barkha Nath Printing Press. New Delhi. India.
Gupta, S.K., 2003. Plant Breeding: Theory and Techniques. AGROBIOS. India.
Maxsted, N., B.V. Ford lioyd and J.J. Hawkes (Ed.). 1997. Plant Genetic Conservation. Chapman and Hall. Inc., London.
McDonald, M. B. and L. O. Copeland, 1998. Seed Production: Principles and Practices. CBS Publishers and Distributors. Chapman and Hall. Inc., New York.
Poehlman, J.M. and D.A. Sleper, 1995. Breeding Field Crops (4th Ed.). Panima Publishing Corporation. New Delhi. India.
Singh, B.D., 2007. Plant Breeding: Principles and Methods. Kalyani Publishers. New Delhi. India.

Course: Plant Breeding and Seed Production Technology	**Hrs. Theory: 96 Hrs. Practical:64**
Unit: 1 Basic concept of plant breeding	**Hrs. Theory: 6**
Objectives	Contents
Define Plant breeding. Explain history of plant breeding. Explain nature and goals of plant breeding. List and explain objectives of plant breeding. Describe activities of plant breeding and roles of plant breeder in increasing food production. Describe relationship of plant breeding with other disciplines. List and explain achievements of plant breeding. Explain undesirable consequences of plant breeding. Discuss constraints and future prospects of plant breeding.	Definition, history, nature, goals, objectives, activities, achievements, undesirable consequences of plant breeding .and its relationship with other disciplines. Roles of plant breeder and constraints and future prospects of plant breeding.

Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 2 Domestication, Germplasm conservation and Plant introduction	**Hrs. Theory: 6**
Objectives	Contents
Define domestication and selection. Explain types of selection and changes in plant species under selection. Explain patterns of evolution in crop plants. Define germplasm and list and explain types of germplasm. Define gene pool and explain types of gene pool. Explain collection and conservation of germplasm. Explain centres of diversity of crop plants. Define plant introduction and explain types and procedures of plant introduction. Define acclimatization and list and explain factors affecting acclimatization. Explain purpose of plant introduction.	Definition of domestication, selection, germplasm, gene pool, plant introduction and acclimatization. Basic concepts of domestication, plant introduction, gene pool and acclimatization Centres of diversity and patterns of evolution of crop plants. Types of germplasm, methods of germplasm collection and conservation. Types, procedures and purpose of plant introduction.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 3 Pollination and Reproduction in crop plants	**Hrs. Theory: 7**
Objectives	Contents
Define pollination and list and explain types of pollination. Enlist self, cross and partially pollinated crops. Explain mechanisms promoting self and cross pollination.	Definition and types of pollination and mechanisms enforcing and genetic consequences of self and cross pollination Definition and types of reproduction Definition and types of apomixes

Explain genetic consequences of self and cross pollinated crops. Define reproduction and describe sexual, asexual types of reproduction. Define apomixes and list and explain different types of apomixes. Define male sterility and explain causes and types of male sterility. Define self incompatibility and explain causes and types of self incompatibility. Explain practical applications of male sterility and self incompatibility in plant breeding.	Definition, causes, types and practical applications of male sterility and self incompatibility
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 4 Hybridization, Heterosis and Inbreeding depression	**Hrs. Theory: 10**
Objectives	Contents
Define hybridization and list and explain types of hybridization. List and explain objectives and methods of hybridization. Explain procedures of hybridization. Explain consequences of hybridization. Define heterosis and inbreeding depression. Explain types of heterosis and inbreeding depression. Explain roles of plant breeder considering heterosis. Explain genetic basis of heterosis and inbreeding depression. List and explain effects of heterosis and inbreeding. List and explain physiological basis and commercial	Definition, objectives, types, methods, consequences and procedures of hybridization. Definition, types, genetic basis of heterosis and inbreeding depression Roles of plant breeder considering heterosis Effects of heterosis and inbreeding Physiological basis and commercial utilization of heterosis

utilization of heterosis.	
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 5 Breeding Methods	**Hrs. Theory: 10**
Objectives	Contents
Enlist and explain breeding methods (mass selection, pureline, pedigree, bulk and back cross) of self pollinated crops. Enlist and explain breeding methods (mass selection, ear to row, half and full sibs, recurrent selection) of cross pollinated crops. Enlist and explain breeding methods of vegetatively propagated crops.	Definition, objectives, procedures, merits and demerits of different breeding methods (mass selection, pureline, pedigree, bulk and back cross, ear to row, half and full sibs, recurrent and clonal selection) of self and cross pollinated and vegetatively propagated crops.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 6 Mutation and Polyploidy	**Hrs. Theory: 6**
Objectives	Contents
Define mutation and list its characteristics and limitations. Explain types of mutation. Define mutagens and list types of mutagens. Define haploid, monoploid, diploid and polyploid. List and explain different types heteroploids and polyploids. List and explain applications of mutation and polyploidy in plant breeding.	Basic concepts of mutation and polyploidy. Definition of common terms. Types of mutation, heteroploids and polyploids. Application of mutation and polyploidy.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation,

	illustration, diagrams, visuals, text books and reference books.
Unit: 7 Basic concepts of seed technology, seed and quality seeds.	**Hrs. Theory: 6**
Objectives	Contents
Define seed technology, seed and quality seed. Explain relationship between seed technology to other disciplines. Differentiate between seed and grain. Explain roles and goals of seed technology, importance and scope of seed and its nutritional value. Enlist and explain seed quality characteristics. Enlist and explain types of improved seeds.	Definition of seed technology, seed, grain and quality seed. Roles, goals and relationship to other sciences of seed technology. Importance and scope of seed and its nutritional value. Seed quality characteristics and types of improved seeds.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 8 Seed growth, dormancy, germination, vigour and longevity	**Hrs. Theory: 5**
Objectives	Contents
Explain seed formation, development and growth and list and explain factors affecting seed growth and development. Define seed dormancy and list and list and explain factors affecting it. Explain breaking seed dormancy. Define and explain seed germination and factors affecting it. Define and explain seed vigour and its role in crop establishment. Explain seed longevity and causes of seed deterioration.	Seed formation, development and growth and factors affecting seed growth and development. Seed dormancy and factors affecting it and breaking seed dormancy. Seed germination and factors affecting it. Seed vigour and its role in crop establishment. Seed longevity and causes of seed deterioration.

Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 9 Principles of seed production	**Hrs. Theory: 5**
Objectives	Contents
Enlist and explain genetic principles of seed production. Enlist and explain agronomic principles of seed production. Explain principles and schemes of nucleus and breeder's seed production. Explain basic principles of hybrid seed production.	Genetic and agronomic principles of seed production. Principles and schemes of nucleus and breeder's seed production. Hybrid seed production.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 10 Types of varieties and seed production schemes	**Hrs. Theory: 5**
Objectives	Contents
Define and explain different types of varieties (pureline, hybrids, synthetics, multilines, composites and clones). Outline and explain production schemes of pureline, hybrids, synthetics, multilines, composites and clones varieties. Define and explain different types of hybrids (single cross, three way cross, double cross and triple cross). Outline and explain production scheme of hybrid seeds using male sterile and self incompatible lines.	Definition and types of different varieties. Production schemes of different varieties. Definition and types of different hybrids. Production scheme of hybrids using male sterile and self incompatible lines.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.

Unit: 11 Influence of seed quality on crop establishment, growth and yield	**Hrs. Theory: 4**
Objectives	Contents
List and explain different factors affecting plant density and crop yield. Explain seeding and stand establishment. Explain seed quality and seedling emergence. List and explain the effects of seedling emergence on crop yield. Explain seed quality and post emergence growth. Explain seed quality and crop yield.	Factors affecting plant density and crop yield. Seeding and stand establishment. Seed quality and seedling emergence. Effects of seedling emergence on crop yield. Seed quality and post emergence growth and crop yield.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 12 Foundation and certified seed production	**Hrs. Theory: 15**
Objectives	Contents
Explain the procedures of producing foundation and certified seeds in cereals (paddy, maize, wheat, millets). Explain the procedures of producing foundation and certified seeds in pulses (pigeon pea, lentil, chick pea, pea, French bean). Explain the procedures of producing foundation and certified seeds in oil crops (rape and mustard, sunflower). Explain the procedures of producing foundation and certified seeds in fibre crops (cotton, jute). Explain the procedures of producing foundation and certified seeds in sugar crops (sugar cane, sugar beet). Explain the procedures of producing foundation and certified seeds in vegetables (potato, tomato, okra, gourds, carrot, radish, onion and cole crops).	Procedures of producing foundation and certified seeds in cereals, pulses, oil crops, fibre crops, sugar crops and vegetable crops.

Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.
Unit: 13 Seed drying, cleaning, upgrading, testing, certification, legislation and intellectual property rights.	**Hrs. Theory: 11**
Objectives	Contents
Explain methods and procedures of seed drying. Explain methods and procedures of seed cleaning and upgrading. Explain methods of seed testing (purity, germination, viability and vigour, seed moisture and seed health). Mention the minimum seed certification standards of different crops. Explain field and seed inspection. Define and explain seed legislation and seed law. Explain intellectual property rights and list and explain forms of intellectual property rights protection.	Methods and procedures of seed drying, cleaning, upgrading and seed testing. Minimum seed certification standards of different crops. Field and seed inspection. Seed legislation and seed law. Intellectual property rights, forms of intellectual property rights protection.
Evaluation Methods: Oral and written tests, assignments.	**Teaching/Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, text books and reference books.

Practical

Plant Breeding and Seed Production Technology practical	**Hrs. Practical: 64**
Practical 1: Collection and conservation of germplasms.	**Hrs. Practical: 2**
Objectives	Contents
Identify different types of germplasms.	Identification of different types of germplasms.

Collect and list different types of germplasms. List and explain methods of conservation germplasms.	Collection and listing of different types of germplasms. Methods of conservation germplasms.
Practical 2 Floral morphology and pollination behavior of cereal field crops	**Hrs. Practical: 3**
Objectives	Contents
Study floral morphology of cereals. Draw floral parts of cereals. Study pollination behavior of cereals. Observe flowers available in the field/lab.	Floral morphology of cereals. Drawing of floral parts of cereals. Pollination behavior of cereals. Observation of flowers in the field/lab.
Practical 3 Floral morphology and pollination behavior of legumes	**Hrs. Practical: 3**
Objectives	Contents
Study floral morphology of legumes. Draw floral parts of legumes. Study pollination behavior of legumes. Observe flowers available in the field/lab.	Floral morphology of legumes. Drawing of floral parts of legumes. Pollination behavior of legumes. Observation of flowers in the field/lab.
Practical 4 Floral morphology and pollination behavior of various vegetable crops	**Hrs. Practical: 3**
Objectives	Contents
Study floral morphology of various vegetable crops. Draw floral parts of various vegetables. Study pollination behavior of various vegetables. Observe flowers available in the field/lab.	Floral morphology of vegetables. Drawing of floral parts of various vegetables crops. Pollination behavior of vegetable crops Observation of flowers in the field/lab.
Practical 5 Hybridization techniques in cereal crops	**Hrs. Practical: 3**
Objectives	Contents

Define hybridization List and explain objectives of hybridization in cereals Observe floral parts and pollination time of hybridizing crop in the field Explain methods and procedures of hybridization in cereals available in the field	Hybridization and its objectives Observation of floral parts and pollination time Methods and procedures of hybridization in cereals
Practical 6 Hybridization techniques in legumes	**Hrs. Practical: 3**
Objectives	Contents
List and explain objectives of hybridization in legumes Observe floral parts and pollination time of hybridizing crop in the field Explain methods and procedures of hybridization in legumes available in the field	Objectives of hybridization in legumes Observation of floral parts and pollination time Methods and procedures of hybridization in legumes
Practical 7 Hybridization techniques in vegetable crops	**Hrs. Practical: 3**
Objectives	Contents
List and explain objectives of hybridization in vegetable crops Observe floral parts and pollination time of hybridizing crop in the field Explain methods and procedures of hybridization in vegetable crop available in the field	Objectives of hybridization in vegetable crops Observation of floral parts and pollination time Methods and procedures of hybridization in vegetable crops
Practical 8 Plant breeding data recording	**Hrs. Practical: 3**
Objectives	Contents
List and explain major types of field record books Explain importance of keeping field record List, identify and study morphological, physiological and yield attributing traits Practice on taking data of different traits of a given crop available in the field	Major types of field record books Importance of keeping field record Morphological, physiological and yield attributing traits Data recording, analyzing and interpreting the results

Analyze the data and interpret the results	
Practical 9 Identification of seeds of various field crops in the laboratory	**Hrs. Practical: 3**
Objectives	Contents
Define seed and grain Differentiate between seed and grain Explain nutritional value of seed Identify different types of seeds of various crops available in laboratory List and explain the observable characteristics of seeds of various crops available in the laboratory	Seed and grain Nutritional value of seed Identification of different types of seeds of various crops Observable characteristics of seeds of various crops
Practical 10 Seed purity test in laboratory	**Hrs. Practical: 2**
Objectives	Contents
Define seed lot/sample and seed purity Mention history of seed testing List components of seed lot Explain importance of doing purity test Explain procedures of purity test Observe, record and calculate seed purity of a given crop in the laboratory Draw conclusions from this test	Seed lot/sample and seed purity History of seed testing Components of seed lot Importance of doing purity test Procedures of purity test Observation, recording and calculation of purity test and drawing conclusions
Practical 11 Seed viability and moisture testing in laboratory	**Hrs. Practical: 2**
Objectives	Contents
Define seed viability Explain importance of seed viability and moisture testing Explain methods and procedures of seed viability and moisture testing of a given crop in lab Observe, record and calculate seed viability and seed	Seed viability Importance of seed viability and moisture testing Methods and procedures of seed viability and moisture testing

moisture draw the conclusions	Observation, recording and calculation of seed viability and seed moisture and drawing conclusions
Practical 12 Seed germination test in laboratory and field	**Hrs. Practical: 10**
Objectives	Contents
Define seed germination List and explain types of seed germination Practice on seed germination test in lab and field Observe, record and calculate seed germination Compare seed germination in lab and field and draw conclusions Explain and estimate real value of seed	Seed germination and its types Methods of seed germination test in lab and field Observation, recording and calculation of germination test Comparison of germination test in lab and field and drawing conclusions Real value of seed
Practical 13 Seed production technique of self pollinated crops	**Hrs. Practical:**
Objectives	Contents
Explain mode of pollination of self pollinated crops List self pollinated crops Know pollination behavior, time and floral morphology of self pollinated crops Know the seed production principles of self pollinated crops List and explain seed production steps of self pollinated crop available in growing season Grow seeds of a given self pollinated crop in the field Harvest the seeds	Mode of pollination of self pollinated crops Listing self pollinated crops Pollination behavior, time and floral morphology of self pollinated crops Seed production principles of self pollinated crops Seed production steps of self pollinated crop available in growing season
Practical 14 Seed production technique of cross pollinated crops	**Hrs. Practical: 9**

Objectives	Contents
Explain mode of pollination of cross pollinated crops List cross pollinated crops Know pollination behavior, time and floral morphology of cross pollinated crops Know the seed production principles of cross pollinated crops List and explain seed production steps of cross pollinated crop available in growing season Grow seeds of a given cross pollinated crop in the field Harvest the seeds	Mode of pollination of cross pollinated crops Listing cross pollinated crops Pollination behavior, time and floral morphology of cross pollinated crops Seed production principles of cross pollinated crops Seed production steps of cross pollinated crop available in growing season
Practical 15 Hybrid seed production technique	**Hrs. Practical: 6**
Objectives	Contents
Define hybrid Mention importance and objectives of hybrid seed production List crops producing hybrid seeds in Nepal Select lines and grow seeds of selected lines in the field List and explain the steps involving hybrid seed production Harvest hybrid seeds	Definition of hybrid Importance and objectives of hybrid seed production Listing crops producing hybrid seeds in Nepal Line selection and growing of selected lines in the field Steps involving hybrid seed production
Practical 16 Visit and study seed processing plant and seed testing laboratory in Hetauda	**Hrs. Practical: 3**
Objectives	Contents
Explain seed drying, cleaning, grading List and explain seed processing procedures Observe seed processing plant List and explain seed testing methods and steps Observe seed testing lab Submit report after visiting and studying seed	Seed drying, cleaning, grading Seed processing procedures Seed testing methods and steps Observation of seed processing plant and seed testing lab Submission of report

processing plant and seed testing lab	
Practical 17 Visit and study seed multiplication farms of National Maize Research Program and National Grain Legumes Research Program in Rampur	**Hrs. Practical: 3**
Objectives	Contents
List type of seed multiplication farms of NMRP and NGLRP in Chitwan and Nepal List type of seed multiplication Explain seed multiplication procedures from seed selection to harvesting Observe seed multiplication farms in Rampur Submit report after visiting and studying seed multiplication farms	Type of seed multiplication farms Type of seed multiplication Seed multiplication procedures from seed selection to harvesting Observation of seed multiplication farms Submission of report
Practical 18 Survey of seed storage structures and seed production system of farmers	**Hrs. Practical: 3**
Objectives	Contents
Define survey List and explain methods of surveying List seed storage structures adopted by farmers Explain seed production system adopted by farmers Submit survey report	Survey and methods of surveying Seed storage structures Seed production system adopted by farmers Submission of a survey report

Industrial Entomology and Mushroom Cultivation

Credit hours: 3+1/week **Full Marks: 100**

Total hours:160 hours

Theory: 96 hours

Practical: 64 hours

Course Description

This course will enable the students to understand and develop knowledge and skills on history and evolutionary process of honey bees, various aspects of honey bee biology, behavior and their management for the production, utilization and marketing of honey and other bee hive products. The course also provides basic knowledge and skills on the silkworm and mushroom cultivation and their utilization.

Course Objectives

This Course has the following Objectives:

- Understand and explain the importance, history and biology of honey bees, silk worm and mushroom for the production of honey, silk and mushroom.
- Develop knowledge and skills on the management of honey bees, silk worm and mushroom to produce, process and marketing of honey, silk and mushroom.
- Demonstrate the importance of commercialization of industrial entomology and mushroom production to generate more food and income.

Minimum Standards

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

Text and reference books

Apiculture:

The hive and the honey bee by Dadant and Sons Inc. Hamilton, Illinois.

Beekeeping technology by Khem Raj Neupane

Asian bees and beekeeping. 2000. A progress of research and development. Ed by Matsuka, M. L.R. Verma, S. Wongsiri, K. K. Shrestha and U. Pratap

Beekeeping by E. F. Phillips

Bee flora of the Hidukush Himalayan, inventry and management by Uma Pratap

Perspective in Indian apiculture by R. C. Mishra.

Guide to bees and honey by T. Hopper.

Medical aspects of beekeeping byR. Harry.

The Asiatic hive bees-Apiculture, biology and role in sustainable development in tropical and subtropical Asia. Ed by Kevan, P. G. Pub by Enviroquest.

Genetic diversity of Himalayan honeybees by L. R. Verma

Sericulture:

An introduction to sericulture by Ganga

Silkworm in Nepal by Ritesh Raj Shrestha

Principles of sericulture by Hisao Aruga

Mushroom cultivation:

Mushroom cultivation in Nepal by Shiva Shankar Sharma

Modern mushroom cultivation technology by Jaya Kanta Raut

Training manual on mushroom cultivation technology by Prof Shu -Ting Chang

Course: Industrial Entomology and Mushroom Cultivation	**Hrs. Theory : 96 Hrs. Practical : 64**
Unit- 1. Introduction, importance and history of apiculture	**Hrs theory : 10**
Objectives	Contents
Define apiculture Explain the objective of apiculture Define common terms in apiculture Understand history and evolutionary process of honey bees Explain importance, scope and problems of beekeeping in Nepal Explain the Zonal sharing of honey bee species in Nepal Classification of honey bees	Definition and objectives of apiculture Common terms in apiculture History and evolution of honey bees and beekeeping Prospectus, potential and problems of beekeeping in Nepal Honey bee species diversities in the world and Nepal Classification of honey bees

Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, group discussion, illustration, diagrams, visuals, textbooks, and reference books.
Unit 2. Anatomy and physiology of honey bees	**Hrs Theory 10**
Objectives	Contents
Define life cycle and caste differentiation of honey bees Explain the anatomy and physiology of honey bees Specialized structure of honey bees	Description of life cycle and caste differentiation External morphology and physiology of honey bees Importance of specially modified structure of honey bees
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 3. Activities and behavior of honey bees	**Hrs Theory 12**
Objectives	Contents
Explain the inside hive activities of honey bees Understand the outside hive activities of honey bees Define the activities and behavior of honey bees in between the hive and field	Brood rearing, thermo regulation, honey ripening, applying propolis, packaging pollen, hive cleaning, hygienic behavior, communication, swarming, absconding and migration, worker laying. Reproduction Foraging Robbing, drifting, fanning, and defense Dancing
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction,observation, illustration, diagrams, visuals, textbooks, and reference books.

Unit 4. Management of honey bees	**Hrs Theory 12**
Objectives	Contents
Define the seasonal management of honey bees Explain the management of honey bees for honey production Understand the management of honey bees against pesticide poisoning Explain the role of honey bees for plant pollination Management of honey bees for crop Pollination Artificial feeding of honey bees	Management of honey bees during different seasons Management of honey bees for maximizing honey production Pesticide poisoning and management of honey bees against pesticides Honey bees and crop pollination Artificial feeding of honey bees
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 5 . Pests, predators and diseases of honey bees	**Hrs Theory 8**
Objectives	Contents
Define pests, predators and diseases of honey bees Identify the pests, predators and diseases of honey bees Understand the preventive and control method for pests, predators and diseases of honey bees	Identification of pests, predators and diseases of honey bees Damaging symptoms of pests, predators and diseases of honey bees Prevention and control measures of pests, predators and diseases of honey bees
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 6 . Post harvest handling and quality control	**Hrs theory 6**
Objectives	Contents

Understand the post harvest handling of honey Explain the mechanisms of quality control of honey	Post harvest handling of honey Quality control of honey
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 7. Introduction to sericulture	**Hrs Theory 8**
Objectives	Contents
Define sericulture Understand the prospectus, potential and problems of rearing silkworm in Nepal Explain the common terms used in sericulture	Definition and history of silkworm rearing in Nepal Prospectus, potential and problems of silkworm rearing in Nepal Commonly used terms in sericulture
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 8. Silk production	**Hrs Theory 10**
Objectives	Contents
Explain the types of sericulture Explain life cycles of silkworm Study management of host plants of silkworm Study silk worm rearing and management Study post harvest handling of silk	Explanation of types of sericulture and life cycle of silk worm Methods of cultivation and management of host plants of silk worm Techniques of silk worm rearing and management Silk peeling, throwing, dying and weaving
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 9 . Diseases and pests of silk worm	**Hrs theory 6**

Objectives	Contents
Study the pests of silk worm Study the diseases of silk worm	Pests of silk worm, their symptoms and control measures Diseases of silk worm, their symptoms and control measures
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 10 . Introduction, importance and scope of mushroom cultivation	**Hrs theory 8**
Objectives	Contents
Define mushroom cultivation Understand the importance of mushroom cultivation Study the prospectus, potential and problems of mushroom cultivation in Nepal	Introduction and definition Importance of mushroom cultivation Prospectus, potential and problems of mushroom cultivation
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 11 .Mushroom cultivation	**Hrs theory 10**
Objectives	Contents
Understand the types of mushroom Develop knowledge and skills on spawn production Study the cultivation practices of mushroom	Types of mushroom Spam production Mushroom cultivation
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 12. Insect pests and diseases of mushroom	**Hrs theory 6**

Objectives	Contents
Identify the insects and pests of mushroom Study the diseases of mushroom	Insect pests of mushroom Diseases of mushroom
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Industrial Entomology and Mushroom Cultivation Practical

Industrial Entomology and Mushroom Cultivation	**Hrs Practical : 64**
Practical 1: Honey bee species and bee products	**Hrs : 8**
Objectives	Contents
Identity the different species of honey bee. Identity the different honey bee products.	Identification and habitats of different species of honey bee species. Study the various honey bee products and their importance.
Practical 2: Beekeeping tools and equipments	**Hrs 8**
Objectives	Contents
Identity the different types of bee hives Study the different types of beekeeping tools and equipment	Identification of various indigenous and modern bee hives with their specific parts Identification of beekeeping tools and equipments Visit to bee farms
Practical 3: Morphology and anatomy of honey bees	**Hrs 8**
Objectives	Contents
Study the external morphology of worker, drone and queen honey bees Study the specialized structure of honey bees	Microscopic observation of external features of worker, drone and queen bees

Study the reproductive systems of honey bees	Microscopic observation of modified structures of honey bees Reproductive systems of honey bees
Practical 4: Handling of honey bees	**Hrs 10**
Objectives	Contents
Demonstrate how to handle honey bees Colony inspection and record keeping Migration of honey bees Artificial feeding of honey bees Colony management for honey production Harvesting and post harvest handling of honey	Handling and working with honey bees. Inspect the honey bee colonies and keep record. Prepare and migrate honey bee colonies for honey production. Harvesting and processing of honey.
Practical 5: Honey bee forage	**Hrs 6**
Objectives	Contents
Identify the honey bee forage Study the flowering duration and carrying capacity of bee forage	Visit to the crop field and forest area Develop the honey bee forage calendar
Practical : 6. Pests, predators and diseases of honey bees	**Hrs 8**
Objectives	Contents
Study the pests and predators of honey bees Study the diseases of honey bees	Pests and predators of honey bees Diseases of honey bees
Practical :7 Silk production	**Hrs 8**
Objectives	Contents
Identify the host plant of silkworm\ Study the cocoon production and processing Identify the pests and diseases of silkworm	Identification of host plants of silkworm Production of cocoon and processing Method of silk extraction, dyeing weaving Insects, pests and diseases of silkworm
Practical 8. Mushroom cultivation	**Hrs 8**

Objectives	Contents
Study the preparation of mushroom compost Study the spawn inoculation procedures Study the organic nutrition supplement Identify the pests and diseases of mushroom Study the harvesting and marketing of mushroom	Preparation of mushroom compost Spawn inoculation procedures Organic nutrition supplement Insects pests and diseases of mushroom Harvesting and marketing of mushroom

Ornamental Horticulture and Nursery Management

Total hours: 2+1/week: 128 hours **Full Marks: 100**

Theory: 64 hours

Practical: 64 hours

Course Description

This course provides basic knowledge on importance, feasibility and skill on principles and practices of landscape, flower production, plant propagation, nursery management, ornamental horticulture situation, important ornamental plants, gardening and bio-aesthetic planning of Nepal.

Course Objectives

Provide basic knowledge and skill on principles and practices of landscape, flower production, plant propagation and nursery management.

Understand ornamental horticulture situation in Nepal and important ornamental plants of Nepal.

Be able to understand landscaping, gardening and bio-aesthetic planning.

Minimum Standards

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

Text and Reference books

Bailey L.H. 1949. Manual of Cultivated Plants. The McMillan Company, New York, USA.

Bajracharya D., Shrestha K.K. and Chaudhary. 1997. Garden Flowers: An Illustrated Guide to Indoor and Outdoor Garden Plants in Nepal. The King Mahendra Trust for Nature Conservation (KMTNC), Lalitpur, Nepal.

Bose T.K., Maiti R.G., Dhua R.S. and Das P. 1999. Floriculture and Landscaping. Naya Prokash., India.

Lauria A. and Victor H.R. 2001. Floriculture: Fundamentals and Practices. Agrobios, India.

Nambisan K.M.P. 1992. Design Elements of Landscape Gardening. Oxford & IBH.

Randhawa G.S. and Mukhopadhyay A. 1986. Floriculture in India. Allied Publ., India.

Sabina G.T. and Peter K.V. 2008. Ornamental Plants for Gardens. New India Publ. Agency, India.

Valsalakumari et al. 2008. Flowering Trees. New India Publ. Agency, India

Course: Ornamental horticulture and Nursery management	**Theory : 64 (hrs) Practical : 64(hrs)**
Unit- 1 Introduction	**Hrs theory :5**
Objectives	Contents
Know the importance and status of nursery business in Nepal	Definition and objectives Common terms used in ornamental horticulture 1.1 Meaning, importance and scope of floriculture in Nepal 1.2 Status of floriculture in Nepal 1.3 Classification of ornamental plants
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit-2 Garden	**Hrs theory :5**
Objectives	Contents
Know the style of garden	Definition, importance and classification Design Component 2.1 Meaning and scope 2.2 Garden styles 2.3 Garden components 2.4 Principles of landscape gardening 2.5 Landscape designs Preparation and maintenance of lawn

Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 3. Ornamental plants	**Hrs Theory 16**
Objectives	Contents
Know the cultivation practices of commercial important cut flower. 3.1	Description and evolution of concept Kinds of succession (Primary, Secondary) Causes of succession 3.1 Cultivation with respect to uses, area of production and trade, variety, soil and climatic requirement, planting, manuring, training and pruning, and disease and insect control of rose, tuberose, gladiolus, marigold, dahlia, chrysanthemum, gerbera, carnation, orchids and cactus 3.2 Indoor gardening 3.2.1 Selection and maintenance of plants 3.2.2 Pot culture and hanging baskets 3.2.3 Flower arrangement and Ekebana 3.3 Bonsai making 3.4 Post harvest aspect of cut flower and vase studies
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 4. Introduction to nursery	**Hrs Theory 4**

Objectives	Contents
Explain nursery business	4.1 Definition of nursery 4.2 Type of nurseries 4.3 Importance and scope in Nepal 4.4 Status of nurseries in Nepal
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 5 Nursery media	**Hrs Theory 4**
Objectives	Contents
Make different potting mixture and their concept	Media, type of media and characters Inorganic and organic media Mixture of container grown plant 5.1 Characteristics of media 5.2 Properties and use of 5.2.1 Soil 5.2.2 Sand 5.2.3 Compost 5.2.4 Vermiculite 5.2.5 Sphagnum moss 5.3 Mixture for container growing 5.4 Treatment of media and mixes
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 6 Nursery container and structures	**Hrs Theory 4**
Objectives	Contents
Know the principle of protected horticulture	Nursery container such as plastic pot, clay pot, wood container etc

	Propagating structure Green house types and principles **Nursery containers** 6.1 Clay pots 6.2 Plastic pots 6.3 Polyethylene bags 6.4 Wooden boxes **Nursery structures** Hotbed 6.5 Plastic tunnel 6.6 Lath house/shade house 6.7 Greenhouse
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 7 propagation from seeds	**Hrs theory 5**
Objectives	Contents
Know the methods of propagation **Propagation from seeds** Merits and demerits Collection of tree seeds	Sexual propagation Advantage and disadvantage o of sexual propagation Dormancy Germination Seed treatment Care and maintenance 7.1 Seeds: viability and germination 7.2 Seed dormancy and its causes 7.3 Breaking seed dormancy 7.4 Preparation of seedbed 7.5 Seedbed treatment and sowing

	7.6 Care and maintenance of seedling 7.7 Packaging and marketing
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 8 Vegetative propagation	**Hrs Theory 8**
Objectives	Contents
Describe about the Reasons for using vegetative propagation.	Advantage and disadvantage of vegetative propagation Reasons for using vegetative means Types of cutting, layering, physiological basis of rooting Grafting and budding Types of grafting Types of budding Physiology of grafting and budding Maintenance of clone i. Propagation of seedless plants ii. Avoidance of long juvenile phase iii. Control of growth form iv. Economics a. Methods of propagation i. Cutting 1. Advantages and disadvantages 2. Different techniques

	ii. Layering 1. Advantages and disadvantages 2. Physiological basis 3. Different techniques iii. Grafting and budding 1. Merits and demerits 2. Different techniques
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 9 Micro propagation	**Hrs Theory 2**
Objectives	Contents
Explain the meaning and concept of mist and micro propagation	Mist propagation, tissue propagation Advantage and disadvantage
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 10 Care and maintenance of asexually propagated plants	**Hrs Theory 4**
Objectives	Contents
Describe about • Transfer to containers and nursery bed • Training and pruning while in nursery • Hardening of nursery plants before sale • Insect pest and disease management • Packaging and marketing	Types of container, problem of container grown plants, root pruning and shoot pruning Hardening of seedling Insect pest management Packing material and marketing

Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.

Practical

Ornamental horticulture and Nursery management **Practical**	**Hrs Practical : 64**
Practical 1: Identify and classify ornamental plant	**Hrs :4**
Objectives	Contents
Identify the different flowers Identify the different foliage and shrubs	Visit farm Visit different nursery for identification
Practical 2: Perform Propagation of ornamental plants by cutting and layering	**Hrs : 6**
Objectives	Contents
Propagation of horticultural plants by cutting Propagation of ornamental plants by layering	Different types of cutting Types of layering
Practical 3: Prepare soil and air layers	**Hrs : 4**
Objectives	Contents
Media preparation Methods of air layering	Layering on flowering tress Air layering on ornamental shrubs
Practical 4: Perform propagation by grafting and budding	**Hrs : 6**
Objectives	Contents
Practice of grafting on ornamental plants Budding in roses	Raising rootstock Collection scion Preparation of planting material
Practical 5: Care and maintain nursery plants	**Hrs : 4**
Objectives	Contents
Practice on potting Practice on repotting	Potting , repotting, handling, cleaning of flowering pots

Practical 6: Perform packaging, handling and marketing of nursery plants	**Hrs : 4**
Objectives	Contents
Practice of packing of annual plants Handling of propagating materials Marketing	Selection of materials Packing and handling procedure Marketing of nursery plants
Practical 7: Prepare bonsai making	**Hrs : 4**
Objectives	Contents
Practice of bonsai making	Preparation of media Container selection Types of bonsai Training and pruning of bonsai
Practical 8: Prepare nursery beds and annual beds	**Hrs : 4**
Objectives	Contents
Nursery bed preparation Types of nursery	Field preparation and making nursery bed for annual flowers
Practical 9: Prepare media and soil mixture for container grown plants	**Hrs : 4**
Objectives	Contents
Preparation of media Proportion of different mixture	Media selection , media preparation and filling pot for planting flowering plants
Practical 10: Perform Flower arrangement	**Hrs : 4**
Objectives	Contents
Practice on making Table bouquet Hand bouquet Car decoration	Types of flower arrangement Preparation of different types of flower arrangement on college
Practical 11: Prepare potting mixture and potting and repotting	**Hrs : 4**
Objectives	Contents

Different between potting and repotting	Repotting, root pruning and training of different pots available in college
Practical 12: Perform training and pruning of ornament plants	**Hrs : 4**
Objectives	Contents
Perform Trimming of hedge Perform training and pruning in ornamental shrubs	Making topiary in college, hedge maintenance in garden Pruning in rose garden
Practical 13: Prepare and maintain lawn	**Hrs : 4**
Objectives	Contents
Demonstrate the methods for preparing field for lawn Demonstrate the selection of grasses Demonstrate planting methods	Field preparation and planting dubo Making lawn
Practical 14: Preparation of landscape designs for residential and public building, and park.	**Hrs : 6**
Objectives	Contents
Describe the principle and design of garden Landscape concept	Preparation of landscape design within the college or public park
Practical 15: Nursery and flower exhibition visit	**Hrs : 4**
Objectives	Contents
Visit flower exhibition Perform mtivation for entrepreneurship	Visit the national level flower exhibition

Fruit and Plantation Crops

Creadit hours: 3+1/week **Full Marks: 100**

Total hours: 160 hours

Theory: 96 hours

Practical: 64 hours

Course Description

This course provides basic knowledge on importance, feasibility and niches for cultivation of fruit and plantation crops in Nepal including classification of fruit crops, influence of environmental factors on fruit and plantation crops, orchard establishment, basic orchard management practices, different stages of growth and development, different plant growth regulators and their application, cultivation practices of major fruit and plantation crops of Nepal.

Course objectives:

This course will be delivered to the students with the broad objective to make them capable to demonstrate knowledge and skill on basic cultivation practices of major fruit and plantation crops.

The specific objectives are as follows:

Provide basic concept on feasibility and niches for cultivation of fruit and plantation crops in Nepal.

Able to classify fruit crops.

Describe effects of different environmental factors on fruit and plantation crops.

Explain how to establish and manage orchard.

Describe concept on different stages of growth and development.

Gain knowledge on use of PGRs.

Develop skill in cultivation of major fruit and plantation crops of Nepal.

Text and Reference books

Bal, J.S. 1990. Fruit Growing. Kalyani Publisher.

Bose, T.K. and S.K. Mitra. 1990. Fruits- Tropical and Subtropical, Naya Prakash, Cucutta.

Chattopadhyaya, T.K. A Text Book on Pomology. Vol I-IV. Kalyani Publisher, Ludhiana.

Kunte, Y.N. and K.S. Yawalker. 1991. Introduction to Principles of Fruit Growing. Agri-

horticulture Publication, Nagpur.

Mitra, S.K., T.K. Bose and D.S. Rathore. 1991. Temperate Fruits. Horticulture and Allied Publisher, Culcutta.

Kumar, N., A. Khader, P. Rangaswami, and I. Iruppalan. 2000. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford and IBH Publishing Co. Pvt. Ltd.

Shunmugavelu, K.G. and V.N. Madhav Rao. 1980. Spices and Plantation Crops. India Book House, New Delhi

Course: Fruit and Plantation Crops	**Hrs. Theory: 96 Hrs.Practical :64**
Unit- 1 Introduction	**Hrs theory : 5**
Objectives	Contents
• Define Horticulture • Explain the potentialities and problems of horticulture • Define ecological regions and describe the potential area for major fruit and plantation crops in Nepal • Classify fruit and plantation crops	Meaning and branches of horticulture Importance, feasibility and constraints of fruit and plantation crops in Nepal Ecological regions and niches of fruit and plantation crop production in Nepal Different ways to classify fruit and plantation crops
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit-2 Environmental factors affecting fruit and plantation crops production	**Hrs theory : 8**
Objectives	Contents
Enlist environmental factors affecting fruit and plantation crops production Explain the effect of temperature on growth and production of fruit crops Describe the effect of different aspects of light on growth and production of fruit crops	Temperature Light Rainfall and humidity Aspect and hailstorm Soil moisture Role of climate on fruit crop distribution in Nepal

Mention the influence of rainfall and humidity on growth and production of fruit crops Explain role of soil moisture on fruit and plantation crops Role of climate on distribution of fruit and plantation crops in Nepal	
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, demonstration, illustration, visuals, textbooks, reference books.
Unit 3. Orchard establishment	**Hrs Theory 6**
Objectives	Contents
Describe different factors to be considered to select the site for the establishment of orchard Mention different system of orchard layout	Site selection for orchard establishment Climate and weather Soil and land slope Irrigation and drainage facility Services Market Orchard lay-out Windbreak and shelter belt Selection of fruit crop and variety Procuring and planting of saplings
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, demonstration, illustration, visuals, textbooks, reference books.
Unit 3. Orchard management practices	**Hrs Theory 9**
Objectives	Contents
Explain different systems of training fruit and plantation crops Describe the pruning techniques Explain different orchard soil management practices	Training and pruning of fruit crops Orchard soil management practices to improve/ maintain soil fertility Green manuring Mulching

Discuss irrigation and drainage methods What are different soil and water conservation practices	Cover cropping Intercropping Crop rotation Alley cropping Sod culture Contour cropping Liming Weeding Irrigation and drainage methods Soil and water conservation practices
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, demonstration, illustration, visuals, textbooks, reference books.
Unit 5. Growth and development	**Hrs Theory 12**
Objectives	Contents
• Explain dormancy of seed and bud • Discuss germination process • Define juvenility and maturity • Describe the flowering, fruiting, fruit set, fruit growth phenomena • Discuss the causes and remedial measures of fruit drop • Define ripening and senescence	Germination and dormancy (seed and bud dormancy) Juvenility Maturity Flowering and fruiting Fruit set, fruit growth and fruit drop Ripening and senescence
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 6 Plant growth regulators	**Hrs Theory 8**
Objectives	Contents
Define Plant growth regulators and classify them Explain the function and commercial use of auxins, gibberellins, cytokinins, ethylene, ABA and growth	Meaning and classification of Plant growth regulators Function and commercial use of

retardants	Auxins Gibberellins Cytokinins Ethylene Abscissic acid Growth retardants
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Classroom instruction, Observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 7 Cultivation practices of tropical fruit crops	**Hrs theory 15**
Objectives	Contents
Discuss major tropical fruit crops of Nepal with respect to area, production, climate, soil, cultivar, propagation, training, pruning, cultural operation, fruiting, harvesting, marketing, disease, insect pest	major tropical fruit crops of Nepal with respect to area, production, climate, soil, cultivar, propagation, training, pruning, cultural operation, fruiting, harvesting, marketing, disease, insect pest of the following fruit tropical fruits: Mango, banana, pineapple, papaya, jackfruit
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, orchard observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 8 Cultivation practices of sub tropical fruit crops	**Hrs theory 15**
Objectives	Contents
• Explain major sub tropical and temperate fruit crops of Nepal with respect to area, production, climate, soil, cultivar, propagation, training, pruning, cultural operation, fruiting, harvesting, marketing, disease, insect pest	Major sub tropical and temperate fruit crops of Nepal with respect to area, production, climate, soil, cultivar, propagation, training, pruning, cultural operation, fruiting, harvesting, marketing, disease, insect pest of the following subtropical fruits: Citrus, litchi, guava, pomegranate

Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, orchard observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 9 Cultivation practices of temperate fruit crops	**Hrs theory 10**
Objectives	Contents
• Discuss major temperate fruit crops of Nepal with respect to area, production, climate, soil, cultivar, propagation, training, pruning, cultural operation, fruiting, harvesting, marketing, disease, insect pest.	Major temperate fruit crops of Nepal with respect to area, production, climate, soil, cultivar, propagation, training, pruning, cultural operation, fruiting, harvesting, marketing, disease, insect pest of the following temperate fruits : Apple, pear, peach, walnut, kiwi, almond, persimmon, strawberry, grapes
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, orchard observation, illustration, diagrams, visuals, textbooks, and reference books.
Unit 9 Cultivation practices of plantation crops	**Hrs theory 8**
Objectives	Contents
• Explain tea, coffee and cardamom with respect to botany, use, area, production, climate, soil, planting, propagation, training, pruning, irrigation, weeding, harvesting, processing, storage, marketing, insect pest and disease control	Study of following crops with respect to botany, use, area, production, climate, soil, planting, propagation, training, pruning, irrigation, weeding, harvesting, processing, storage, marketing, insect pest and disease control. Tea Coffee Cardamom
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, orchard observation, diagrams, visuals, textbooks and reference books.

Fruit and Plantation Crops Practical

Course: Fruit and Plantation Crops	**Hrs Practical : 64**
Practical 1: Identification of fruit and plantation crops	**Hrs : 2**
Objectives	Contents
Acquaint with major fruit and plantation crop of Nepal Classify different fruit and plantation crops	Define fruit and plantation crops Visit the horticulture orchard and identify the fruit and plantation crops Classify fruit and plantation crops in various ways
Practical 2: Identification of horticultural tools and equipment used in cultivation of fruit and plantation crops	**Hrs : 2**
Objectives	Contents
Identify the horticultural tools and equipments used in orchard Acquainted with the method to handle them and upkeep of equipment.	Different horticultural tools, their uses and regular maintenance Categorization of tools and equipments according to their uses in orchard
Practical 3: Mapping of Nepal regarding potential growing areas of major fruit and plantation crops	**Hrs : 2**
Objectives	Contents
Understand the total area and production of major fruit and plantation crop of Nepal Acquainted potential growing areas of different fruit and plantation crops in Nepal Cassify Nepal into different agro climatic zones	Total area, productive area and production of major fruit and plantation crop in Nepal Agro ecological zoning of Nepal regarding the production of fruit in Nepal Agro ecological zoning of Nepal regarding the plantation crops in Nepal Potential areas for different fruit and plantation crops in Nepal
Practical 4: Lay-out of orchard	**Hrs : 4**
Objectives	Contents
Familiar with different system of layout of fruit orchards	Different layout systems for establishment of fruit orchard in plain area

Know the planting distances of major fruit and plantation crops Acquainted with proper planting distance of different fruit crops Calculate the number f plants required to establish orchard in different systems of planting.	Orchard layout systems for hilly area Planting distance for different fruit crops depending upon species, cultivars, use of rootstock Calculation of plant population in different layout systems
Practical 5: Lay-out of tea garden	**Hrs : 2**
Objectives	Contents
Acquainted with layout of tea garden in Nepal Establish tea garden	Layout of tea garden Different factors to be considered while establishing the tea garden
Practical 6: Digging and filling back of pits and planting of fruit saplings	**Hrs : 6**
Objectives	Contents
Understand the importance of digging pits prior to planting fruit sapling Dig pits of different size Know about the filling back of dug pits Familiar with the techniques to uplift the sapling from nursery and plant them in orchard field	Pit digging- significance and pit size Appropriate Filling back techniques Balled , Burlapped and bare rooted sapling Plating fruit sapling in the main field
Practical 7: Training of fruit and plantation crops	**Hrs : 6**
Objectives	Contents
Understand the basic principles of training fruit and plantation crops Train different fruit and plantation crops	Objectives of training fruit and plantation crops. Training systems of major fruit and plantation crops. Training for pruning fruit trees.
Practical 8: Pruning of fruit and plantation crops	**Hrs : 4**
Objectives	Contents
Familiar with pruning techniques Acquainted with time and intensity of pruning Understand the physiology of fruit trees after pruning	Principle of pruning fruit and plantation crops Relationship between the pruning and bearing habit of fruit trees

	Pruning time and pruning intensity
Practical 9: Fertilizing, manuring and calculation of fertilizer required for fruit trees	**Hrs : 4**
Objectives	Contents
Acquainted different manure and fertilizers Calculate the amount of fertilizer required for fruit trees Understand the time, appropriate place and method to apply fertilizer to fruit trees	Manures and fertilizers applied to fruit trees. Nutrient content available in different manures and fertilizers Calculation of required amount of fertilizers Proper time and place to apply fertilizer
Practical 10: Preparation and application of Bordeaux mixture, paste and paint	**Hrs : 4**
Objectives	Contents
Familiar with different concentration of Bordeaux mixture and paste Prepare and apply Bordeaux mixture and paste	Bordeaux mixture – formulation and preparation Preparation and application of Bordeaux paste Preparation and application of Bordeaux paint
Practical 11: Preparation of different concentrations of PGR and their application	**Hrs : 2**
Objectives	Contents
Familiar with different PGR used in fruit and plantation crops Prepare and spray PGR solution of different strength	PGRs used in orchards Preparation of PGR solution of different dilution and their application
Practical 12: Preparation of different concentrations of pesticides and their application	**Hrs : 2**
Objectives	Contents
Acquainted with various pesticides used in fruit and plantation crops Prepare and spray pesticides solution of different strength	Pesticides applied in orchards Preparation of pesticide solution of different concentration and their application
Practical 13: Practices of cutting, layering, grafting and budding	**Hrs : 10**
Objectives	Contents

Perform cutting to propagate fruit and plantation crops Develop skill to perform different types of layering fruit trees Develop skill to do different types of grafting fruit trees Improve skill to do different types of budding fruit trees	Use of different propagation methods to propagate major fruit and plantation crops Different types of cutting Layering- different methods Different grafting methods Various techniques of budding
Practical 14: Method of irrigation of fruit trees	**Hrs : 2**
Objectives	Contents
Know the critical stages to irrigate fruit trees Gain knowledge regarding different irrigation systems	Different irrigation systems for fruit orchards Critical period and frequency of irrigation
Practical 15: Major diseases of fruit and plantation crops	**Hrs : 2**
Objectives	Contents
Identify major diseases of fruit and plantation crops Familiar with control measures against the major diseases	Major diseases of fruit and plantation crops with their scientific name Remedial measures to control them
Practical 16: Major insect pests of fruit and plantation crops	**Hrs : 2**
Objectives	Contents
Familiar with major insect pests of fruit and plantation crops Know about control measures against the major insect pest	Major insect pests of fruit and plantation crops with their scientific name Preventive measures to control them
Practical 17: Sampling and preparation of orchard soil for analysis	**Hrs : 2**
Objectives	Contents
Collect the soil sample from orchard Prepare the soil sample to send it for analysis	Soil sample collection methods Preparation of soil sample and working sample
Practical 18: Collection and preparation of leaf sample for analysis	**Hrs : 2**

Objectives	Contents
Develop skill to collect the leaf sample from different fruit and plantation crops Prepare the leaf sample for laboratory analysis	Leaf sample collection method Drying and preparation of leaf sample for further analysis
Practical 19: Harvesting of fruit	**Hrs : 2**
Objectives	Contents
Familiar with maturity indices of fruit Acquainted with harvesting methods of fruit	Judging the time to harvest fruit Harvesting techniques to minimize damage to fruit
Practical 20: Coffee processing	**Hrs : 2**
Objectives	Contents
Harvest coffee Familiar with processing of coffee bean	Coffee harvesting Pulp removal, roasting and further processing

Work Experience Program (WEP)

Credit Hours: 0+12 **Full Marks**: Practical 300

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.

Syllabus

Management system of organization**,** Familiarity with improved agriculture technogy and development activities, study of socioeconomic, cultural and Innovative agricultural technogy of farming community, data collection, analysis, report preparation and presentation.

Activity:

In this program the students will be placed in the job market under the supervision of supervisors in the organizations such as (agriculture farm, research institution, tea plantation or tea processing plant, NGOs/INGOs working in agriculture and community fields etc.). The nature of the training is practical works and the duration will be of three (3) months (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 training 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.

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	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 placement
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) Detail plan of work of WEP during 3 months (90 days)/480 hours.

SN	Activities	Days	Remarks
1	Gain knowledge and experience about the daily official works and activities of the WEP site: Organizational structure; duty ,responsibility, facilities(salary, perk, benefits, leave system, PF, gratuity, pension etc) of the employee of WEP site organization; Annual work plan, reporting system	5 days	
2	Work experience: Involvement in calendar operation of Agriculture farms/agriculture research institution/Agriculture industry/NGOs, INGOs involved in agriculture to familiar with agriculture technogy or development activities or farm record keeping system carried out by these organizations. Minimum: one crop season activities	60 days	
3	Community field work experiences: data collection about socioeconomics and cultural aspects and farming system of the purposively selected ethnic community such as Darai community, Tharu community, Musahar, Chepang, Dalit, Brahman- Chetri, Gurung, Magar and other Mixed type of communities and impact assessment of community who reside on the periphery of organization	10 days	
4	Preparation and presentation of report on format developed by CTEVT	15	
	Total	**90 days**	

C) 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 40 percent marks in the external examination conducted by CTEVT to pass the course.**

Revision of Diploma in Agriculture (I. Sc Ag Plant Science)

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