CURRICULUM

DIPLOMA

Medicinal and Aromatic Plants

Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

2019

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Introduction

This 3 years Diploma in Medicinal and Aromatic Plants curricular programme is designed for producing skilled Junior Technician equipped with required knowledge, skills and attitudes for cultivation, harvesting, processing and products development of medicinal and aromatic plants. Many types of valuable Medicinal and Aromatic Plants (MAPs) are available in different parts of Nepal. However, it is in practice of collecting such plants from forest and exports as raw materials without initial processing. Initial processing of such plants helps for value addition. There is high potentiality of domestication of such medicinal and aromatic plants in Nepal. Domestication practices are introduce in recent days in small scale. This curricula program is design in line with the domestication in large scale, processing them and products development of medicinal and aromatic plants available in the country.

The course of Diploma in Medicinal and Aromatic Plants extends over three years in yearly system having theoretical and practical parts. The first year courses focus on the basic sciences and foundational subjects such as; English, Nepali, Physics, Chemistry, Mathematics, Botany and Zoology similar to Diploma in Agriculture (Major: Plant Science and Animal Science) program. The second year focus on the core subjects of medicinal and aromatic plants such as; Extension and Community Development, Plant Taxonomy and Pharmacognosy, Ecology and Phytogeography, Nursery Management, Agro-technology of Medicinal and Aromatic Plants, Ethnobotany, Non Timber Forest Products (NTFP), Herbal Product Development, Sustainable Management and Utilization.

The third year course focus on the core subjects such as; Post Harvest Technology, Processing Technology, Quality Management of MAPs, Sales, Marketing and Branding of MAPs, Agribusiness Management and Cooperative, etc. Similarly learned theory and practical will be applied in real practice throw work experience programme (WEP). This course focuses on harvesting, post harvesting, processing, products development technology as well as marketing, grading, packaging, branding of herbs, medicinal and aromatic plants. Apart from this, they are also rendered additional knowledge through seminars, discussions, case studies, and presentations. This course is based on the job required to perform by Junior Technician of medicinal and aromatics plants.

Rational

Nepal is very rich in natural resources. Many types of medicinal and aromatic plants are available in different ecological zone of Nepal. Maximum utilization of such plants is big challenge. Domestication of such valuable plants is another challenges of the country due to lack of technical human resources. Very few products are collection from the forest and sell them as a raw materials without any processing. These plants can use to make medicine. Now a day protection, domestication and maximum utilization of such plants are in the priorities of Government of Nepal. Some initiation has been taken by the private sectors towards the domestication, processing and products development from medicinal and aromatic plans. However there is lack of competent technical human resources in the country. To fulfil the gap of such technical human resources, this course has been initiated jointly by CTEVT, GoN Department of Plant Resources, Nepal Herbs & Herbal Products Association and Herbal Entrepreneurs Association.

Curriculum Title:
Diploma in Medicinal and Aromatic Plants

Programme Aims
This program aims to produce skilled middle level technical workforce of Medicinal and Aromatic Plants equipped with required knowledge, skills and attitudes.

Programme Objectives
After completion of this course graduates will be able to:

1. Identify different medicinal and Aromatic plants available in different parts of the country.
2. Perform nursery management, domestication and harvesting practice of MAPs.
3. Carryout processing of MAPs for value addition.
4. Develop different products from MAPs.
5. Carryout Marketing, Branding and quality management of MAPs.
6. Carryout work at medicinal and aromatic plants farms, governmental and non-governmental organizations, processing & products development organizations as Junior Technician.
7. Become self-employed in related sectors.

Group Size
The group size will be maximum of 40 (Forty) students in a batch.

Entry Criteria
- SLC pass or SEE with minimum C grade in any two subjects and D+ in any one subject in compulsory Mathematics, English & Science.
- TSLC in relevant discipline with minimum 67.00%.

Course Duration
The **Diploma in Medicinal and Aromatic Plants** program extends over three academic years. It is a yearly program. One academic year consists of maximum of 40 academic weeks excluding evaluation periods and one academic week consists of maximum of 40 contact hours.

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

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

Teacher and Student Ratio
- Overall ratio of teacher and student must be 1:10 (at the institution level)
- For theory:- 1:40
- For practical/lab/demonstration:- 1:10
- 75% of the teachers must be full timer.

Qualification of Teachers and Instructors:

- The program coordinator and foundational subject related teacher should be master degree holder in the related area.
- The disciplinary subject related Instructors and Demonstrators should be a bachelor's degree holder in the related area.

Instructional Media and Materials:

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

- ***Printed Media Materials*:** Assignment sheets, handouts, information sheets, individual training packets, performance checklists, textbooks etc.).
- ***Non-projected Media Materials:*** Display, flip chart, poster, writing board etc.
- ***Projected Media Materials:*** Opaque projections, multimedia projector, slides etc.
- ***Audio-Visual Materials:*** Audiotapes, films, slide-tape programmes, videodiscs, videotapes etc.
- ***Computer-Based Instructional Materials:*** Computer-based training, interactive video etc.

Teaching Learning Methodologies:

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

Theory: Lecture, discussion, interaction, illustrated talks, tutorial, assignment, demonstration, group work etc.

Practical: Demonstration, observation, guided practice, self-practice, simulation, project work, field work, real practice, industrial practice, report writing, term paper presentation, etc.

Mode of Instruction

Mainly inductive or both deductive and inductive mode will be applied.

Examination and Marking Scheme

a. Internal assessment

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

b. Final examination

- Weightage of theory and practical marks are mentioned in course structure.
- Students must pass in all subjects both in theory and practical for certification. If a student becomes unable to succeed in any subject, s/he will appear in the re-examination administered by CTEVT.

- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

c. Requirement for final practical examination

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

d. Final practicum evaluation will be based on:

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

e. Pass marks:

- The students must secure minimum 40% marks in theory and 60% marks in practical. Moreover, the students must secure minimum pass marks in the internal assessment and in the semester final examination of each subject to pass the subject.

Provision of Back Paper

There will be the provision of back paper but a student must pass all the subjects of all years within six years from the enrollment date.

Disciplinary and Ethical Requirements

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

Grading System

The following grading system will be adopted:

- Distinction: 80% or above
- First division: 65% to below 80%
- Second division: 50% to below 65%
- Pass division: Pass aggregate to below 50%

Certification and Degree Awards

- Students who have passed all the components of all subjects of all 3 years are considered to have successfully completed the program.
- Students who have successfully completed the program will be awarded with a degree of **"Diploma in Medicinal and Aromatic Plants"**.

Career Opportunity

The graduates of Diploma in Medicinal and Aromatic Plants will be eligible for the position equivalent to Non-gazetted 1st class/level 5 (technical) as "**Junior Technician (JT)**" or as prescribed by the Public Service Commission or the concerned authorities of Nepal. The graduates will be eligible to apply for the entrance examination of Bachelors Degrees administered by the Institute of Agriculture and Forestry. The graduates also will be eligible to apply for the entrance examination of Bachelors Degrees administered by the Zoology and Botany Departments of other university.

Question Patterns for Written Exam

The question patterns for written exam are suggested as follows;

A. For subject with full marks 80

S. N.	Type of question	No of question	Weightage fomarks	Full marks	Time distribution	Optional questions
1	Long	3	8	24	54 min	1
2	Short	8	4	32	72 min	2
3	Very short	12	2	24	54 min	2
	Total	**23**		**80**	**180 min**	

B. For subject with full marks 64

S. N.	Type of question	No of question	Weightage fomarks	Full marks	Time distribution	Optional questions
1	Long	3	6	18	54 min	1
2	Short	7	4	28	72 min	2
3	Very short	9	2	18	54 min	2
	Total	**20**		**64**	180 min	

C. For subject with full marks 40

	Type of question	No of question	Weightage fomarks	Full marks	Time distribution	Optional questions
1	Long	2	6	12	27	1
2	Short	4	4	16	36	1
3	Very short	6	2	12	27	1
	Total	**12**		**40**	**90 min**	

Course Structure

First Year

SN	Subject	Credit hour/week	Contact hour/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	Zology	4+1	6	100
	Total	32+4	40	850

Second Year

SN	Subject	Credit hour/week	Contact hour/week	Full marks
1	Extension and Community Development	3+1	5	100
2	Plant Taxonomy and Pharmacognosy	3+1	5	100
3	Ecology and Phytogeography	2+0	2	50
4	Nursery Management of Medicinal and Aromatic Plants	2+1	4	100
5	Agro-technology of Medicinal and Aromatic Plants	2+1	4	100
6	Ethnobotany	2+0	2	50
7	Non Timber Forest Products (NTFP)	2+1	4	100
8	Herbal Product Development	2+1	4	100
9	Sustainable Management and Utilization	2+1	4	100
10	Statistics and Computer Application	2+1	4	100
	Total	22+8	38	900

Third Year

SN	Subject	Credit Hour/week	Contact hours/week	Full marks
1	Policies, Trade and Export of MAPs	2+1	4	100
2	Post Harvest Technology	2+1	4	100
3	Processing Technology	2+1	4	100
4	Quality Managementof MAPs	2+1	4	100
5	Sales, Marketing and Branding of MAPs	3+1	5	100
6	Entrepreneurship Development	3+1	5	100
7	Agribusiness Management and Cooperative	3+1	5	100
8	Work Experience Program (WEP)	0+4	8	300
	Total	17+11	39	1000
	Grand Total	95		2500

Note:

1. One practical credit hour = Two contact hours
2. Work Experience Program (WEP): 2 months (3 months *4 weeks*40 hours = 480 hours)
3. WEP should be completed before third year final examination.
4. The WEP plan is attach herewith.

Detail of Credit Hours and Marks

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	Plant Taxonomy and Pharmacognosy	3	2	5	16	64	3	8	12	3	100
3	Ecology and Phytogeography	2	0	2	10	40	3	0	0		50
4	Nursery Management of Medicinal and Aromatic Plants	2	2	4	16	64	3	8	12	3	100
5	Agro-technology of Medicinal and Aromatic Plants	2	2	4	16	64	3	8	12	3	100
6	Ethnobotany	2	0	2	10	40	3	0	0		50
7	Non Timber Forest Products (NTFP)	2	2	4	16	64	3	8	12	3	100
8	Herbal Product Development	2	2	4	16	64	3	8	12	3	100
9	Sustainable Management and Utilization	2	2	4	16	64	3	8	12	3	100
10	Statistics and Computer Application	2	2	4	16	64	3	8	12	3	100
	Total	**22**	**16**	**38**	**148**	**592**		**64**	**96**		**900**

Third Year

SN	Subject	Mode		Weekly hours	Distribution of Marks						Total Marks
					Theory			Practical			
		T	P		Internal	Final	Time	Internal	Final	Time	
1.	Policies, Trade and Export of MAPs	2	2	4	16	64	3	8	12	3	100
2.	Post Harvest Technology	2	2	4	16	64	3	8	12	3	100
3.	Processing Technology	2	2	4	16	64	3	8	12	3	100
4.	Quality Management of MAPs	2	2	4	16	64	3	8	12	3	100
5.	Sales, Marketing and Branding of MAPs	3	2	5	16	64	3	8	12	3	100
6.	Entrepreneurship Development	3	2	5	16	64	3	8	12	3	100
7.	Agribusiness Management and Cooperative	3	2	5	16	64	3	8	12	3	100
8.	Work Experience Program (WEP)	As per WEP rules									300
	Total	**17**	**14**	**31**	**112**	**448**		**56**	**84**		**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.

Course Contents

Part 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..
Part 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 पूर्णाङ्कः १००**
कुल समय : १६० घण्टा

परिचय र उद्धेश्य: 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 परिचय: 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) ङ्, ञ्,ण्, न्,म्, तथा शिरविन्दु र चन्द्विन्दु
ऊ) हलन्त सम्बन्धी नियम र अपवादहरु
ए) पदयोग र पदबियोग सम्बन्धी नियमहरु
ऐ) तत्सम शब्दका सन्दर्भमा उपसर्ग र प्रत्यय सम्बन्धी वर्णविन्यास ।

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

एकाई ३: शब्दवर्ग र शब्दरुपायन: अङ्क:१० पाठ्यभार: १२

क) स्रोत: तत्सम, तद्भव र आगन्तुक, व्युत्पादन: पूर्वसर्ग (उपसर्ग), परसर्ग (प्रत्यय), समास र द्वित्व (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) अंङ्क : १० पाठ्यभार : १२

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

ख) सर्गपद्धतिद्वारा शब्दनिर्माण (

पूर्वसर्ग (उपसर्ग) द्धारा 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) द्धारा 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:

ली, 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) समासद्धारा शब्दनिर्माण

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

घ) द्वित्वद्धारा शब्दनिर्माण : द्वित्व र अन्य व्युत्पादन प्रक्रियामा फरक, पूर्ण र आंशिक द्वित्व प्रक्रियाद्धारा शब्दनिर्माण गर्ने अभ्यास ।

ङ) सन्धि नियम : नेपाली 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, द्विकर्मक 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 ।

ङ) भाव/अर्थ

अ) भाव वा अर्थको परिचय

आ) सामान्यार्थ, विध्यर्थ (आज्ञार्थ, इच्छार्थ), अनिश्चयार्थ (सम्भावनार्थ, संङ्केतार्थ) ।

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 : अङ्क: 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 ।
ङ) 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: अङ्क ५०, पाठ्यभार: ६०

एकाइ १: प्रयोजनपरक नेपाली : अङ्क: ५ पाठ्यभार: ५

क) भाषिक भेदको पहिचान
लिखित र मौखिक भेदको पहिचान
औपचारिक र अनौपचारिक भेदको पहिचान
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 अङ्क: 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 ३: अनुच्छेदलेखन र पत्ररचना:अङ्क: 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 ढाद्दा एवं तरिकाको ज्ञान र अभ्यास: कार्यालयीय पत्र, निवेदन, सूचना, निमन्त्रणापत्र र विज्ञापनको रचनासम्बन्धी ज्ञान र लेखनको अभ्यास ।

एकाइ ४: निबन्ध, टिप्पणी र प्रतिवेदन लेखन: अङ्क: 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 ५: कृतिसमीक्षा: अङ्क: 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 पूर्णाङ्कको 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 अपनाल्ने, 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 गर्ने
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 पुऱ्याउने गरी गोष्ठीविधि पुस्तकालयीय अध्ययनविधिको पनि प्रयोग गर्ने, साथै साहित्यिक र बौद्धिक अतिरिक्त क्रियाकलापका माध्यमलाई पनि प्रयोग गर्ने, यसै क्रममा पाठ्यविषयसंग सम्बन्धित तुल्याई विशिष्ट विद्वान, लेखक आदिको व्याख्यान, प्रवचन आदिको आयोजनालाई पनि सहायक शैक्षिक विधिका रुपमा प्रयोग गर्ने ।

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

एकाइ ६: मूल्याङ्कन योजना :

अवधारणा :

यस तहको मूल्याङ्कन हाल प्रचलित मूल्याङ्कन पद्धतिअनुसार लिखित परीक्षाका माध्यमबाट गरिनेछ । शैक्षिक सस्थाहरुले आफ्ना हिसाबले शैक्षिक स्तर उठाउन आन्तरिक परीक्षालाई पनि मूल्याङ्कनको माध्यम बनाउनेछन् ।

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

प्रयोग :

यसको मूल्याङ्कन 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: 192 **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.

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 Contents

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 Explain Pascal's law and Archimedes's principle. State the principle of flotation and condition of equilibrium of floating bodies.	Fluid pressure and determination of the formula $P=\rho gh$. Pascal's law. Density and specific gravity. Difference between density and specific gravity. Working principle of pumps 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.	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.

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).	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. Determine relative humidity by wet and dry bulb hygrometer. Explain Air conditioning. Solve related numerical problems.	Definition of saturated and unsaturated vapors. Definition of triple point. Definition of dew point, absolute humidity and relativity humidity. Explanation of dryness and dampness. 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. 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.	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. 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.	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.

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. Draw ray diagrams to solve problems involving spherical mirrors. Derive the formula 1/u+1/v= 1/f	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. 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 $d=t(1-1/\mu)$ and lateral shift $P=t[\sin(i-r)]/\cos r$. Derivation of the formula$\mu=1/\text{Sin}c$. 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.	Explain defects of vision- Myopia and Hypermetropia. Definition of 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.	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. Define capacitance. Derive E=V/d, for parallel plates capacitor	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

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. 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	Current as the rate of flow charge Potential deference Ohm's law and its verification Expression $R=R_1+R_2+R_3+$.....and $1/R=1/R_1+1/R_2+1/R_3+$..... in series and parallel combination. Conversion of a galvanometer into ammeter and voltmeter. Ohmic and non-Ohmic conductors from I-V curve. Conversion of galvanometer into voltmeter and ammeter. Simple numerical problems.
Evaluation methods: written and viva exams performance observation	**Teaching/learning activities and resources:** classroom instruction and demonstration, return demonstration models, solving related problems
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.	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.

State Lenz's law. State principle and working of a.c. generator. Solve related numerical problems.	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	Photoelectric effect, quantum theory of radiation. Einstein's photoelectric equation $hv=\varphi+1/2mv^2$ and interpretation. Simple problems using photoelectric equations. Explanation of postulates of Bohr's theory of hydrogen atom.

State 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. 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	The constitutions of nuclei. Isotopes and mass numbers of different elements $E=mc^2$ (only qualitatively) Fission, fusion, and energy released from these nuclear reactions Radiation hazard and safety. Calculation of mass, defect and loss of mass due to radioactive disintegration numerically.

Explain Einstein's mass-energy relationship theory. Define fission and fusion and calculate the energy released Discuss health hazards and safety related to radiation.	
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 and medicinal & aromatic plants. 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 and medicinal & aromatic plants.
- 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.

Recommended Texts

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

Course Contents

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. Define ratio and proportion and their properties. Sum of infinite geometric series. Define Means.	Formulae of A.P., G.P and H.P. Ratio and proportion and their properties. Formula of AM, GM and HM. Relation between AM, GM and HM.
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	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. (Theorem prof's are not required) Try only exercise I (1), (2), (3) and (4) from the textbook of grade XI

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)	
Evaluation Methods: written Assignments to solve relatedproblems, 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**
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.
1.4: 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, teacherled discussion, demonstration of solutions, illustration through practical examples, text and reference books.
1.5: 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).	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.

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 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.
1.6: 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.) 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 ($ax^2+2hxy+by^2=0$)	Equation of straight line in three standard forms. Find the equation of straight line in from one point and slope are given (point slope form.) Find the equation of straight line from two given points. Find the angle between two straight lines and condition of perpendicularity and parallelism. Find the length of perpendicular to straight line from a given point. Line pair equation, two equations of straight lines as a single equation. 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
1.7: 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.
1.8: 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.
1.9: 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.
1.10: Trigonometry	**Hrs Theory 15**
Objectives	Contents
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	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.
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.

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 Prakashan, 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, 1st Indian edition-1987.
10. Soil Science.
11. N.K Vishnoi Advanced Practical Organic Chemistry.- Second revised edition Vikas Publishing Pvt-Ltd.

Course Contents

Course: Chemistry	**Hrs. theory 128 Hrs. lab 64**
Unit 1: Physical Chemistry	**Hrs. theory 47**
1.1: 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. Q. What is the quantitative significance of a chemical equation?	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 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.	Modern periodic classification of elements. Location of s, p, d, f-block elements Periodicity in properties by:

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?	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. Q. Which one, CO_2 or SO_2, diffuses faster and why?	Effect of pressure and temperature on volume of gas Boyle's law, Charles'slam combined gas lawa, daltion law of partial pressure 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 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	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
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. 2. Explain the importance of osmosis ephemeron.	Dilute and concentrated solution 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. 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	Reason for large number of organic compounds- Tetrvalency 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. Q. What are attacking reagents? Give two examples of each.	Carbocation and carbanion. Inductive effect (+1 and -1 effect) 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.	Preparation from benzene diazonium chloride and sodium benzene sulphonate, physical properties.

Explain action with Na, Zn, NH_3, benzenediazonium chloride kolbe's reaction.	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 1. Describe the chlorination of water 2. List advantage and disadvantage of hard water	Soft and hard water The process of removal of hardness: - Boiling, Clark's process using washing soda, permutit process, soda-ash method, deionization of water

3. Explain the method of purification of drinking water 4. Define degree of hardness of water 5. Define heavy 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 **9.** Describe about Iron	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.
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	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

6. Explain Hydrochloric acid	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. 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	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. 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. theoryHrs. 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 and medicinal and aromatic plants. 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.

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 Contents

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: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods:** Classroom instruction, textbooks, reference books, charts, diagrams, photographs, show items containing relevant biomolecules.
2.2 Water	**Theory: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. 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.	Definition of tissue Types of tissues- Meristematic, permanent and secretory Features of Meristematic tissues. Types and examples of Meristematic tissues- apical, intercalary and lateral; primary and secondary Classification of permanent tissues as simple and complex Basic features, distribution and function of different simple and complex permanent tissues Definition of secretory tissues Types of secretary tissues, their examples and importance. Definition of primary and secondary tissues. Types of Xylem- protoxylem and metaxylem; exarch, endarch, mesarch and centrarch. Vascular bundles and its elements-xylem, phloem and cambium. Types of vascular bundles- radial, conjoint(collateral, bicollateral and concentric); open and closed.

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. 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.	Definition of Photosynthesis. Major photosynthetic pigments and their roles Sites of Photosynthesis-grana and stroma of chloroplast Major steps of photosynthesis- trapping of light, light reaction, photolysis of water, photophosphorylation and dark reaction (Calvin cycle) (detail steps and mechanism not required)
Evaluation: 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.	Definition of respiration. Definition of aerobic and anaerobic respiration and their differences Sites of respiration-cytoplasm and matrix and cristae of mitochondria

Give major steps of anaerobic respiration and fermentation.	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.	**Teaching Methods or Materials:**

Types of questions: Very short (1 mark) and Short (3 marks).	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: Oral and written tests, home assignment.	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts and diagrams or demonstration. herbarium

Types of questions: Very short (1 mark), Short (3 marks) and Long (7 marks).	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: Oral and written tests, home assignment. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or materials :** Classroom instruction, textbooks, reference books, charts and diagrams. fresh or preserved plant materials
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.	Definition and general characteristics of Gymnosperms. Major groups of living Gymnosperms and representative species of each group

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.	Systematic position and general morphology of Pinus Definition of mycorrhizal roots of *Pinus* Xerophytic features of *Pinus* needle Economic importance of Gymnosperms
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
5.11: 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 of stigma); Fruit-(definition, basic types and subtypes).	Description of angiospermic plants in semi technical terminologies. habit; general types, parts, features, modifications of root, stem, Leaf, inflorescence, flower
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. **Types of questions:** Very short (1 mark), Short (3 marks) and Long (7 marks).	**Teaching Methods or Materials:** Classroom instruction, textbooks, reference books, charts, and diagrams, show pea plants and introduce its different parts.
Unit 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'. Discuss the scope and value of ethnobotany. Discuss the value and importance of traditional knowledge.	Definition of ethnobotany. 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. List the applications of Plant Tissue Culture.	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.
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.	**Contents** Study of 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. Demonstrate that carbon dioxide is evolved during fermentation.	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 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.* 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).	**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 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.

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 Contents

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.	Evolutionary history of organisms. Evidences of organic evolution. Different theories 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.	
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.
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.
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
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.
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.
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.	Instruments used for dissection Expose the general anatomy, alimentary canal, male reproductive system, female reproductive system and nervous system

Draw the well- labeled diagrams of the given systems and comment on them.	
Evaluation methods : practical performance, test, viva	**Teaching learning activities and resources:** classroom instruction, demonstration
6.2 Dissection of frog	**Hrs. 8 lab**
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.
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.
Unit 7: Study of an ecosystem	
7.1 Pond ecosystem	**Hrs. 4 lab**
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.
7.2 Grassland ecosystem	**Hrs. 8 lab**
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

1. **Extension and Community Development**
2. **Taxonomy and Pharmacognosy**
3. **Phytogeography**
4. **Nursery Management**
5. **Agro Technology**
6. **Ethnobotany**
7. **Non Timber Forest Products**
8. **Herbal Product Development**
9. **Sustainable Management and Utilization**
10. **Statistics and Computer Application**

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.

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, JV. 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 Contents

Course: Extension and Community Development	**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
• 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: Written exam**.**	**Teaching /Learning activities and resources:** 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

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.	Meaning, concept of result demonstration. Precaution used in method demonstration.

• Observe farmer's field trial (FFT).	
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.

Plant Taxonomy and Pharmacognosy

Credit hours: 2+1 hrs./week **Full Marks: 100**
Total hours: 156
Theory: 78 hrs.
Practical: 78 hrs.

Course Description

- This course provides basic knowledge in plant taxonomy and pharmacognosy including diagnostic features of different families and pharmacognosy practices regarding to important Medicinal and Aromatic Plants(MAPs)

Course Objectives
This Course has the following objectives:

- Provide basic information about morphology and general anatomy of medicinally important plant parts
- Give idea aboutherbarium and their preparation and preservation.
- Identify distinguishing features of medicinally important plant families.
- Provide basic idea about pharmacognosy and its application

Books and references:

A Class Book of Botany. A.C. Dutta. Oxford University Press.
Cultivation of Medicinal Plants by C.K. Atal& B.M. Kapoor.
Bhattarai, K.R. and Ghimire, M.D. (2063).*Cultivation and sustainable harvesting of commercially important medicinal and aromatic plants of Nepal*. Heritage Research and Development Forum, Nepal.
Khanal, C., Swar, S. and Tandukar, U. (2018). Handbook of Pharcognosy (Medicinal Plants in Nepal). Depatment of Plant Resources, Thapathali
Rajbhandary, S. and Ranjitkar, S. (2006). *Herbal Drugs and Pharamcognosy.Monographs on Commercially Important Medicinal Plants of Nepal*.Ethnobotanical Society of Nepal.Kathmandu.
Sharma, O.P. (1993). Plant Taxonomy. Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi

Course Contents

Course: Plant Taxonomy and Pharmacognosy	**Hrs. Theory: 78 Hrs. Practical : 78**
Unit 1: Introduction of MAPs	**Hrs theory : 10**
Objectives	**Contents**
▪ To set the scene about MAPs in the context of global regional and local context ▪ To describe the spatial and temporal distribution, changes and concentration of MAPs ▪ To list the government prioritized MAPs for economic and agricultural development	• Global, regional and local scenario of MAPs • Geographical distribution of MAPs • Status of MAPs in Nepal and World • Prioritized MAPs for economic development • Prioritized MAPs for agrotechnology development

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 2: Angiospermic Families	**Hrs Theory 12**
Objectives	Contents
Discuss the characteristic features of medicinally important angiospermic families with examples and economic importance	• Describe the habitat, habit, vegetative and sexual parts in semitechnical terms with floral formula, floral diagram and systematic classification. • Describe diagnostic characters of given plant families • Describe the economic importance of at least five medicinal plants of each family. Asparagaceae, Rutaceae, Rosaceae, Gentianaceae, Valerianaceae, Lauraceae,
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 3: Identification of MAPs	**Hrs theory : 20**
Objectives	**Contents**
• Describethe methods of MAPs • Explain geographical distribution of important MAPs • Explain taxonomic description and uses of MAPs	• Introduce the methods of identification (Morphology, anatomy, pharmacognosy) • Geographical Distribution of MAPs (Timur, Dhasingre, Lemongrass, Mentha, Chamomile, Atis, Chiraito, Lauthsalla, Tejpat, Satuwa, Kurilo, Sarpagandha, Yarsagumba, Kaulo, Ritha, Sugandhawal, Pashanbhed, Sugandhakokila, Kutki, Jatamansi) ▪ Scientific name, local name, common name and family ▪ Distribution in Nepal ▪ Distribution in the world ▪ Taxonomic description and uses of MAPs
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: Herbarium	**Hrs theory : 8**
Objectives	Content
▪ Define herbarium ▪ Describe the function and types of herbarium ▪ List major herbaria in the world ▪ Explain the process of herbarium preparation and preservation ▪ Introduce KATH	▪ Definition of the herbarium ▪ Function of the herbarium ▪ Types of Herbaria ▪ Major herbaria in the world ▪ Herbarium preparation process ▪ Herbarium preservation methods ▪ Herbarium as a tool of identification

	▪ Case study of National Herbarium and Plant Laboratories (KATH) ▪ Taxonomic tools and flora of Nepal
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: Pharmacognosy	**Hrs Theory 6**
Objectives	Contents
Describe pharmacognosy and its scope Explain relation of pharmacognosy with systematic botany and other disciplines Identify the techniques followed in the pharmacognostic study	▪ Introduction to pharmacognosy ▪ Scope of pharmacognosy ▪ Pharmacognosy and its relation with systematic botany and other disciplines ▪ To introduce the instruments used in pharmacognosy ▪ Techniques followed in the pharmacognostic study
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 6: Pharmacognosy of major Aromatic Plants in Nepal	**Hrs Theory 10**
Objectives	Contents
Describe the major aromatic plants and their distribution in Nepal Identify the chemical constituents, macroscopic characters, organoleptic characters and microscopic characters of commercially important medicinal plants of Nepal	Botanical description of plant Distribution in Nepal Chemical constituents Macroscopic characters Organoleptic characters Anatomical characters of ▪ Timur (Fruit) ▪ Dhasingre (Leaf) ▪ Tejpat (Leaf) ▪ Sugandhawal (Rhizome) ▪ Jatamansi (Rhizome)
Unit 7: Pharmacognosy of major Medicinal Plants in Nepal	**Hrs Theory 12**
Objectives	Contents
Describe the major medicinal plants and their distribution in Nepal Identify the Chemical constituents, macroscopic characters, organoleptic characters and microscopic characters of commercially important medicinal plants of Nepal	Botanical description of medicinal plant Distribution in Nepal Chemical constituents Macroscopic characters Organoleptic characters Anatomical characters of ▪ Atis (Tuber) ▪ Chiraito (Stem)

	▪ Lauthsalla (Leaf) ▪ Kurilo (Tuber) ▪ Sarpagandha (Root) ▪ Pashanbhed (Rhizome) ▪ Kutki (Rhizome)
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	**Teaching /Learning activities and resources:**Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.

Plant Taxonomy and Pharmacognosy Practical

Course: Plant Taxonomy and Pharmacognosy	**Hrs. Practical : 78**
Unit 1: Introduction of MAPs	**Hrs practical : 10**
Objectives	**Contents**
▪ Report the government prioritized MAPs for economic and agricultural development.	• Observe and identifythe museum specimens of the government prioritized MAPs for economic • Observe and identify the museum specimens of the government prioritized MAPs for agricultural development
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 2: Angiospermic Families	**Hrs Practical 12**
Objectives	Contents
• Identify, Illustrate and describe the given plant in semi-technical terms	• Describe the habitat, habit, vegetative and sexual parts in semitechnical terms with floral formula and floral diagram • Describe diagnostic characters of given plant families • Give the economic importance of at least five medicinal plants of each family. Asparagaceae (*Asparagus racemosus*) , Rutaceae (*Zanthoxylum armatum*), Rosaceae (*Bergenia ciliata*), Gentianaceae (*Swertia chirayita*), Valerianaceae (*Valeriana jatamansii*), Lauraceae (*Cinnamomum tamala*),
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 3: Identification of MAPs	**Hrs practical : 20**
Objectives	**Contents**

• Identify the parts used of MAPs • Identify the use of given MAPs	• Observe the parts used of given MAPs (Timur, Dhasingre, Lemongrass, Mentha, Chamomile, Atis, Chiraito, Lauthsalla, Tejpat, Satuwa, Kurilo, Sarpagandha, Ashwagandha, Yarsagumba, Kaulo, Ritha, Sugandhawal, Pashanbhed, Sugandhakokila, Kutki, Jatamansi)
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: Herbarium	**Hrs practical : 8**
Objectives	Content
▪ Visit the herbarium aollect the plant specimen ▪ Prepare herbarium or museum specimens from collected specimen of at least 10 medicinally important plant species	▪ Visit nearby herbarium (KATH, Trivuban University Central Department of Botany (TUCH), herbaria of plant research center, University or College herbaria) ▪ Collect the plant specimen from nearby forest and prepare herbarium or museum specimens (at least 10 medicinally important plant species)
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: Introduction to Pharmacognosy	**Hrs Practical 6**
Objectives	Contents
	▪ Observe instruments used in pharmacognosy ▪ Microscope (Simple, Compound) ▪ Microtome ▪ Alcohol series ▪ Safranin ▪ Slides, Cover slip, ▪ Spatula ▪ Forceps ▪ Xylene, Glycerol
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 6: Pharmacognosy of major Aromatic Plants in Nepal	**Hrs Practical 10**
Objectives	Contents
Identify MAPs on the basis of organoleptic characters of given aromatic plants Identify MAPs on the basis of anatomical characters of given aromatic plants	**Organoleptic Practical** ▪ Timur (shape, size, colour, odour and taste of fruit powder) ▪ Dhasingre (shape, size, colour, odour of leaf powder) ▪ Tejpat (shape, size, colour, odour and taste of leaf power)

	▪ Sugandhawal (shape, size, colour, odour and taste of rhizome powder) ▪ Jatamansi (shape, size, colour, odour and taste of rhizome powder) **Anatomical Practical** Prepare the temporary slide of ▪ Timur (TS of fruit) ▪ Dhasingre (VS of Leaf) ▪ Tejpat (VS of Leaf) ▪ Sugandhawal (TS of rhizome) ▪ Jatamansi (TS of rhizome)
Unit 7: Pharmacognosy of major Medicinal Plants in Nepal	**Hrs Practical 12**
Objectives	Contents
Identify MAPs on the basis of organoleptic characters of given aromatic plants Identify MAPs on the basis of anatomical characters of given aromatic plants	**Organoleptic Test** ▪ Atis (shape, size,colour, odour of root powder) ▪ Chiraito (shape, size,colour, odour and taste of plant powder) ▪ Lauthsalla (shape, size,colour, odour and taste of leaf powder) ▪ Kurilo (shape, size,colour, odour and taste of tuber powder) ▪ Sarpagandha (shape, size,colour, odour and taste of root bark powder) ▪ Pashanbhed (shape, size,colour, odour and taste of rhizome powder) ▪ Kutki (shape, size,colour, odour and taste of rhizome powder) ▪ Ashwagandha (shape, size,colour, odour and taste of rhizome powder) **Anatomical Practical** ▪ **Prepare the temporary slide of** ▪ Atis (TS of root) ▪ Chiraito (TS of Stem) ▪ Lauthsalla (TS of Leaf needle) ▪ Kurilo (TS of Tuber) ▪ Sarpagandha (TS of Root) ▪ Pashanbhed (TS of Rhizome) ▪ Kutki (TS of Rhizome) ▪ Ashwagandha (TS of Rhizome)
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	**Teaching /Learning activities and resources:** **C**lassroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journals and publications.

Ecology and Phytogeography

Credit hours: 2+0 hrs./week **Full Marks: 50**
Total hours: 78
Theory: 78 hrs.
Practical: 0 hrs.

Course Description

This course in ecology and phytogeography is designed to provide students with an understanding of the concept of ecology, phytogeography, dynamics of ecosystem and ecological statistics. The courses emphasize on the ecology of Nepal and how it influence vegetation, forests and floral wealth of country. An outline of statistical importance and how it can be used in ecological studying is also provided in the course.

Course Objectives

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

- Describe the concept of ecology and ecosystem and define the ecosystem components and theories
- Describe different types of ecosystems with examples in the context of Nepal and able to explain vegetation types and forest types in Nepal
- Explain the concept of endemism, number of endemic plants in Nepal and different ecological barriers which shape the endemic richness
- Describe the concept and importance of conservation ecology and different practices adopted by Nepal for the conservation of plant genetic resources
- Explain different sampling terminologies, its uses and application of samples in ecological research

Recommended textbooks, articles and websites

1. Chaudhary,R.P.1998.Biodiversity in Nepal (Status and Conservation).S.Devi, Saharanpur (U.P.), India and Tecpress books, Bangkok, Thailand
2. Ambasht R.S. and N.K. Ambasht, 2008. A textbook of plant ecology, 15th edition. CBS Publishers and distributors, Delhi, India
3. MoFE, 2018. Nepal's Fifth Assessment Report submitted to CBD.
4. MoFE, 2014. National Biodiversity Strategy and Action Plans (NBSAP).
5. Schreuder, H.T., Gregoire, T.G. and Weyer, J.P. (2001) for what applications can probability and non-probability sampling be used? Environmental Monitoring and Assessment 66: 281291
6. Hirzel, A. and Guisan, A. (2002) which is the optimal sampling strategy for habitat suitability modelling. Ecological Modelling. 157: 331-341

Course Contents

Course: Ecology and Phytogeography	**Theory: 78 hrs**
Unit 1: Ecology and Ecosystem	**Theory: 10 hrs**
Objectives	**Contents**
• Describe the concept of ecology and ecosystem and give examples of different ecosystems • Define the ecosystem components and theories • Explain the role of anthropogenic pressures in shaping the ecology	1. Development of Ecology 2. Division of Plant Ecology 3. Ecosystem • Ecosystem Components • Gaia Hypothesis • Trophic relations • Productivity concept • Stability controls (homoeostatis) • Types and examples of ecosystems 4. Biotic Interrelationship • Grazing and scraping • Role of animals in pollination and dispersal of seeds and fruits
Unit 2: Flora and Vegetation of Nepal	**Theory: 18 hrs**
Objectives	**Contents**
• Explain vegetation types and forest types in Nepal • Designate floral diversity of Nepal (number, occurrence, habit, habitat, 10 names) according to the registered number of species at National herbarium and Plant Laboratories	1. Vegetation and Forest of Nepal (Vegetation types, Forest category, forest types) 2. Floral diversity in Nepal • Algae • Fungi • Lichens • Bryophytes • Pteridophytes • Gymnosperms • Angiosperms
Unit 3: Phytogeography of Nepal	**Theory: 18 hrs**
Objectives	**Contents**
• Describe phytogeography and its influence in vegetation, forest and floral diversity of Nepal • Explain basic principles and underlined theories in dynamic phytogeography • Describe the concept of endemism, number of endemic plants in Nepal and different ecological barriers which shape the endemic richness	1. Phytogeography of Nepal • Tropical zone • Sub-tropical zone • Temperate zone • Sub-alpine zone • Alpine zone 2. Role of anthropogenic dimensions in dynamic phytogeography 3. Endemism 4. Centre of origin 5. Plant migration and barriers

• Define the convention measures on access to genetic resources and technology transfer • Define world centre of origins for cultivated plants with some examples • Explain the different terms (i) centre of origin (ii) centre of dispersal (iii) centre of variation (iv) centre of frequency (v) centre of preservation	
Unit 4: Conservation Ecology	**Theory: 14 hrs**
Objectives	**Contents**
• Elaborate on article 8 and article 9 in the context of ex-situ and in-situ conservation regarding plant genetic resources • Define the convention measures on access to genetic resources and technology transfer • Describe the different practices of ex-situ conservation adept by botanical gardens, zoos, seed banks, gene banks and other practices especially focusing on their objectives and roles. • Describe the different practices of in-situ conservation adept by national parks, wildlife reserves, conservation areas and forests especially focusing on their objectives and roles • Identify the different actors involved in conservation of plant genetic resources and the conservation practices adopted by them	1. Conservation of plant genetic resources (definition, Article 8, 9, 15, 16 of CBD, advantage and importance) • Ex-situ conservation • In-situ conservation • access to genetic resources • access to and transfer of technology 2. Practices of ex-situ conservation (Definition and role in conservation) • Botanical gardens • Zoos • Seed banks • Field gene banks • In-vitro storage • Cryopreservation • DNA Bank-Net 3. Practices of in-situ conservation(Definition, status-establishment, area, location, major flora and fauna and role in conservation) • National parks • Wildlife reserves • Conservation areas • Protected, sacred forests and wetlands 4. Institutions involved in conservation of plant genetic resources
Unit 5: Ecological Statistics	**Theory: 18 hrs**
Objectives	**Contents**
• Gain knowledge and be able to define sample size, unit and frame for ecological analysis • Explain and be able to identify sampling methods and designs according to population size	1. Statistical sampling • Definition, uses, sample, population, census, Probability and non-probability sampling, Sampling unit and frame • sampling distribution • Applications of sampling distribution 2. Sampling design and methods

• Explain different sampling terms, its uses and application of samples in ecological research	• Sampling design process • Factors to consider in sampling design • Characteristics of a good sampling design • Non-probability sampling approach (convenience sampling, purposive sampling, judgment sampling, quota sampling, snowball sampling) • Probability sampling (Simple random sampling, systematic sampling, stratified sampling, cluster sampling) 3. Determining sample size • Methods for determining sample size • Sample size for the mean • Sample size for the proportion
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources: Class room instruction, Observation, visuals, reading assignment, textbooks, and reference books**

Nursery Management of Medicinal and Aromatic Plants

Credit hours: 2+1 hrs./week Full Marks: 100
Total hours: 156
Theory: 78 hrs.
Practical: 78 hrs.

Course Description
This course provides basic knowledge and skill in nursery management of medicinal and aromatic plants (MAPs) including different terminologies and practices regarding to nursery management.

Course Objectives
This Course has the following objectives:

- Provide basic information about wild and cultivated MAPs
- Generate ideas about different methods of propagation
- Demonstrate nursery management techniques
- Identify design and layout of nurseries
- Explain MAPs species for seedling production

Books and references:

1. Bhattarai, D.2058. *JadibutiManjari.*Suvas printing press, Lalitpur, Nakwahil
2. Bhattarai, K.R. and Ghimire, M.D.2063.*Cultivation and sustainable harvesting of commercially important medicinal and aromatic plants of Nepal*. Heritage Research and Development Forum, Nepal.
3. Keshari, K.A. and Adhikari, K. 2004. A text book of higher secondary Biology Class XII. VidharthiPustakBhandar, Bhotahiti
4. DPR. 2074. *Jadibutitathagairkastha ban paidawarsambandhitalimdigdarsan.*Banaspatibivag, Thapathali
5. DPR. 2062. Khetit*athaanusandhankolagipartamikatamaparekaJadibutiharukoJanakari*.Banaspatibivag, Thapathali
6. Jain, V.K. 1995. *Fundamentals of Plant Physiology*.S.Chandand Company, Ltd., Ram Nagar, New Delhi, India.
7. खिलेन्द्र गुरुङ, दिपेश प्याकुरेल, वसन्त रानाभाट, २०६९, जडिबुटिको प्राङ्गारिक खेती तथा प्रमाणिकरण, नेपाल हर्ब्स तथा हर्वल उत्पादक संघ नेपाल
8. वन, वनस्पति, वन्यजन्तु तथा भूसंरक्षण सम्बन्धी विकास निर्माण कार्यक्रमका लगि दर विश्लेषण नर्मस् २०७०, भाग १, वन तथा वातावरण मन्त्रालय

Course Contents

Course: Nursery Management of Medicinal and Aromatic Plants	**Hrs. Theory: 78 Hrs. Practical : 78**
Unit 1: Life forms and propagatory parts of MAPs	**Hrs theory : 12**
Objectives	**Contents**
• Explain the different life forms of MAPs • Differentiate between wild and cultivated MAPs • Describe parts of MAPs used in propagation • Explain the status of MAPs cultivation in Nepal	1.1 Introduction of MAPs 1.2 Life forms of MAPs (Herbs, Shrubs, Trees and Climbers with example) 1.3 Difference between Wild and cultivated MAPs 1.4 Describe different parts of MAPs used in propagation • Roots– 5 example of MAPs • Leaf– 5 example of MAPs • Stem– 5 example of MAPs • Seed – 5 example of MAPs • Whole plant– 5 example of MAPs
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: Plant growth hormones and regulators	**Hrs Theory 10**
Objectives	**Contents**
• Introduce plant growth regulators • Describe the uses of plant growth regulators	2.1 Definition of hormones and plant growth regulators 2.2 Structure, distribution and uses/ role of • Auxin • Gibberellins • Cytokinin • Ethylene and • Abscissicacid
Evaluation Methods: Written tests, Homeassignments and presentation,participation/interaction in class	Teaching /Learning activities and resources:Teaching/Learning activities and resources: Classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 3: Manures, Fertilizers and Mineral Nutrition of Plants	**Hrs Theory 16**
Objectives	**Content**
• Describe Manures and Fertilizers • List of green crops used as green manures in	3.1 Manures and Fertilizers • Manures : Farmyard Manures (FYM), Composite manures and Green manures

• Identify Mineral nutrition of plantsand their roles • Describe the use and effect of pesticides and bio-pesticides • Explain the Merits and demerits of pesticides	• List of green crops used as green manures in Nepal • Importance of green manures in agriculture • Prospectus of green manures in Nepal • Biofertilizers (Definition, Explanation of bacteria as biofertilizers, cyanobacteria as biofertilizers, fungi as biofertilizers and endomycorrhyza) • Differences between green manures and biofertilizers 3.2 Fertilizers : • Introduction, Types of commonly used fertilizers (Nitrogenous fertilizers : Uses and example; Phosphate fertilizers : Uses and example; Potassium fertilizers : Uses and example) 3.3Mineral nutrition of plants • Introduction of essential and non-essential elements with their example • Classification of essential elements (Macronutrients or major nutrients and micronutrients or minor elements : Definition and example) • Specific roles of macronutrients and their deficiency symptoms in plants :Nitrogen, Phosphorous, Sulphur, Calcium, Magnesium, Potassium and Iron) • Specific roles of micronutrients and their deficiency symptoms in plants : Magnesium, Copper, Zinc, Boron and Molybdenum) 3.4. Bio-pesticides and pesticides • Effective microorganism (EM) • Chemical pesticides • Merits and demerits of pesticides
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching /Learning activities and resources:Teaching/Learning activities and resources: Classroom instruction, illustrations,diagrams, visuals, textbooks and referencebooks, journal and publications.

Unit 4: Plant Propagation	**Hrs Theory 10**
Objectives	**Contents**
Impart the knowledge on process of reproduction in medicinal plant Describe the methods of plant propagation	4.1 Introduction 4.2. Methods of plant propagation 4.2.1 Vegetative propagation : Describe the following process with example of MAPs i. Division ii. Cutting iii. Layering iv. Grafting v. Tissue culture 4.2.2 Sexual propagation (Seeds) Describe the process with example of MAPs Reasons of seeds not germination Germinating test of seeds
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: Shade house and Poly house	**Hrs Theory 10**
Describe methods of construction of Shade house and Poly house Identify the needs of different nurseries according to the needs and land features	5.1 Shade house and Poly house • Introduction • Significance • Differences 5.2 Construction of Shade house and Poly house Shade house construction • Major Requirements : Wood/bamboo, agro net, nails, G.I. hook, Jastapataor dry grasses or straw, skilled manpower • Method of shade house construction 5.3 Poly house construction • Major Requirements : Wood/bamboo, nails, G.I. hook and wire, Sil polin, skilled manpower • Method of shade house construction 5.4 Automatic Green house and its uses 5.5 Tunnel house and its uses
Unit 6: Medicinal and Aromatic Plants Nurseries	**Hrs theory : 10**

Objectives	Content
Introduce the concept and significance of nursery Identify Materials and tools used in nursery : Example Explain Precondition for Site selection for establishing nursery Design temporary andpermanent nursery	6.1 Definition of nursery 6.2 Significance of nursery 6.3 Materials and tools used in nursery : Materials : Soil, sand, manure, iron sieve, labels, fungicides and insecticides, register, pen, pencil, marker, poly bags, Clay pots , iron Shieve, Tray, Hajari, Garden Pipes, sprinkles, poly tank Equipments and tools: Trowel, Hoe, Kuto, Kodalo, Kodali, Savel, Sickle, Sicketure, knife, Dante, seed box, tray, Wheel barrow, Sprayer, pH meter 6.4 General information about the seeds for propagation • Types of seeds • Seed collection • Seed drying and treatment 6.5 Nursery bed preparation • Soil preparation • Preparation of beds • Poly bags preparation • Methods of seed sowing in beds and poly bags • Watering • Picking up (Priking) 6.6 Precondition for Site selection for establishing nursery • Status of land • Sources of Water • Access to the nursery • Soil and sand • Acquisition of labor • Area of nursery • Availability of tools, equipments, materials, manure and chemicals • Drainage • Fencing 6.7 Basis of nursery Design • Layout of nursery beds • Shade house and poly house • Water tap or Water tank or poly tank • Soil, sand and manure • Site for compost manure preparation • Materials, equipment and tools placing site (Store house)

	• Seed storage place 6.8 Types of nursery • Temporary nursery and • Permanent nursery • Differences between temporary and permanent nursery 6.9 Construction of nursery • Requirements for the construction of nursery • Method of construction of temporary nursery • Method of construction of permanent nursery
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: Seedling production technique of Medicinal and Aromatic Plants	**Hrs theory : 18**
Objectives	**Content**
Familiarize the seedling production technique of important medicinal and aromatic plants	**7.1 Propagation method of Atis** • Introduction to the plant • Scientific name, Family, Common name, others name (Local name) • Distribution in world • Distribution in Nepal • Parts used • Uses • Seeds or mother plant selection and collection • Preparation of nursery beds • Seeds sowing time and method • Vegetative propagation • Caring **7.2 Propagation method of Lauthsalla** • Introduction to the plant • Scientific name, Family, Common name, others name (Local name) • Distribution in world • Distribution in Nepal • Parts used • Uses • Seeds or mother plant selection and collection • Preparation of nursery beds

	• Seeds sowing time and method • Vegetative propagation • Caring **7.3 Propagation method of Pasanved** • Introduction to the plant • Scientific name, Family, Common name, others name (Local name) • Distribution in world • Distribution in Nepal • Parts used • Uses • Seeds or mother plant • selection and collection • Preparation of nursery beds • Seeds sowing time and method • Vegetative propagation • Caring **7.4 Propagation method of Kaulo** • Introduction to the plant • Scientific name, Family, Common name, others name (Local name) • Distribution in world • Distribution in Nepal • Parts used • Uses • Seeds or mother plant selection and collection • Preparation of nursery beds • Seeds sowing time and method • Vegetative propagation • Caring **7.5 Propagation method of Mentha** • Introduction to the plant • Scientific name, Family, Common name, others name (Local name) • Distribution in world • Distribution in Nepal • Parts used • Uses • Seeds or mother plant selection and collection • Preparation of nursery beds • Seeds sowing time and method • Vegetative propagation

	• Caring **7.6 Propagation method of Lemongrass** • Introduction to the plant • Scientific name, Family, Common name, others name (Local name) • Distribution in world • Distribution in Nepal • Parts used • Uses • Seeds or mother plant selection and collection • Preparation of nursery beds • Seeds sowing time and method • Vegetative propagation • Caring

Nursery Management of MAPs Practicals

Nursery Management of MAPs Practicals	**Practical hrs: 78**
Practical 1: Introduction to equipment and tools used in nurseries	**Practical hrs: 8**
Objectives	**Content**
• Demonstrateuse ofequipment and tools.	• Identify equipments and tools and their parts • Practice the use of equipments and toolsin the field.
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 2: Introduction to different species of MAPs	**Practical hrs: 16**
Objectives	**Content**
• List major MAPs available in the surrounding forest area. • Prepare a report of above listed MAPs on the basis of their uses.	• Field visit to the surrounding forest and prepare a list of major MAPs • Collect information of local and commercial use of above listed MAPs
Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 3: Visit to different nurseries of MAPs	**Hrs14**
Objectives	**Content**
• Identify major nurseries of MAPs	• Visit selected nurseries of MAPs and collect information of the seedling of major MAPs

Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 4: Construction of Shade house and Poly house	**Hrs. Practical 10**
Objectives	**Content**
Demonstrate construction of Shade house and Poly house	Construct Shade house by using local materials (Wood/bamboo, nails, G.I. hook, galvanized sheet or dry grasses or straw, agro net) Construct Poly house by using local materials (Wood/bamboo, nails, G.I. hook and wire, Silpaulin)s
Practical 5: Seedling production techniques of MAPs	**Hrs. Practical 30**
Objectives	**Content**
• Practice seedlingproduction techniques of any two species of MAPs	• Visit nursery field and practice nursery bed preparation, seed collection, seed treatment techniques, seed germination test, seed sowing and seedling transplanting in polybags, watering, manuring, weeding, grading and root pruning
Evaluation Methods: Written and viva, individual presentation, participation/interaction in the field	**Teaching/Learning activities and resources:** Instruction at the visit site, demonstration, field practical

Agro-technology of Medicinal and Aromatic Plants (MAPs)

Credit hours: 2+1 hrs./week **Full Marks: 100**
Total hours: 156
Theory: 78 hrs.
Practical: 78 hrs.

Course Description
This course provides basic knowledge and skill of cultivation, domestication, Good Agriculture and Collection Practices (GACP) of Medicinal and Aromatic Plants (MAPs).

Course Objectives
This Course has the following objectives:

- Provide basic information about different aspects of extension of cultivation of MAPs
- Generate ideas and develop skill about process of domestication of MAPs
- Familiarizeabout Good Agricultural and Collection Practice (GACP) of commercially important MAPs
- Work as a middle level technician in agro-technology development of MAPs

Books and references:

1. Bhattarai, D.2058. *JadibutiManjari.*Suvas printing press, Lalitpur, Nakwahil
2. Bhattarai, K.R. and Ghimire, M.D.2063.*Cultivation and sustainable harvesting of commercially important medicinal and aromatic plants of Nepal*. Heritage Research and Development Forum, Nepal.
3. DPR 2067 B.S. *NepalkoAarthikBikaskalagiPrathamikta Prapta 30 JadibutiharukoPahichan*
4. *Pustika*, Department of Plant Resources, Ministry of Forest and Soil Conservation, Government of Nepal, Kathmandu.
5. DPR 2007.*Medicinal Plants of Nepal*.Bulletin of the Department of Plant Resources No.28,Department of Plant Resources, Ministry of Forest and Soil Conservation, Governmentof Nepal, Kathmandu.
6. DPR 2074 B.S. *JadibutiSankalan, Sanrakshan, SambardhanBidhi*. JadibutiParichaya Mala 1-5, Department of Plant Resources, Ministry of Forest and Soil Conservation, Government of Nepal, Kathmandu.
7. DPR (Latest publication). *Qu*ality standard, Good agriculture, collection practices of *Asparagus racemosus, Piper longum, Rauvolfia serpentina, Swertia chirayita, Cinnamomum tamala, Valeriana jatamansii, Zanthoxylum armatum, Matricaria chamomilla.* Department of Plant Resources, Ministry of Forest and Soil Conservation, Government of Nepal, Kathmandu.
8. DPR. 2074. *Jadibuti tatha gairkastha ban paidawar sambandhi talim digdarsan,* Banaspatibivag, Thapathali
9. Bhattarai, K.R., Acharya, N. and Adhikari, M.K. 2005. *Domestication of medicinal plants of Nepal: An overview*. In: Plant resources (*Pl*ant Resources Occasional Publication).Department of Plant Resources, Thapathali, Kathmandu *pp 61-66*

10. DPR. 2017. *Good Agricultural Practice (GAP) for Medicinal and Aromatic Plants: General Principlesand Guidelines*. Department of Plant Resources, Thapathali, Kathmandu
11. खिलेन्द्र गुरुङ, दिपेश प्याकुरेल, वसन्त रानाभाट, २०६९, जडिबुटिको प्राङ्गारिक खेती तथा प्रमाणिकरण, नेपाल हर्ब्स तथा हर्वल उत्पादक संघ नेपाल

Course Contents

Course: Agro-technology of Medicinal and Aromatic Plants (MAPs)	**Hrs. Theory: 78 Hrs. Practical : 78**
Unit 1: Aspects of cultivation of MAPs	**Hrs theory : 10**
Objectives	Contents
Describe different aspects of cultivation of **MAPs** Introduce the cultivated MAPs of Nepaland problems in cultivation	1.1 Aspects of cultivation of **MAPs** • Introduction • Climate • Soil • Suitable genotype • Propagation • Disease and pests 1.2 CultivatedMAPs of Nepal 1.3 Problems in cultivation of MAPs
Unit 2: Government prioritized MAPs	**Hrs theory : 10**
Objectives	**Contents**
Introduce government prioritized MAPs for economic development, cultivation and research development of Nepal	2.1 Government prioritized MAPs for economic development of Nepal Nepali name, Botanical name, Common name, Family, Identifying characters, Distribution range in Nepal, Used parts, Uses 2.2 Government prioritized MAPs for cultivation and research or domestication of Nepal Nepali name, Botanical name, Common name, Family, Identifying characters, Distribution range in Nepal, Used parts, Uses
Unit 3: Domestication of MAPs	**Hrs theory : 20**
Objectives	**Content**
Introduce the concept of domestication Describe the history of domestication of MAPs in Nepal Identify the steps and procedures domestication of MAPs	3.1 Introduction 3.2 Important traits to be improved for adopting during process of domestication 3.3 History of domestication of medicinal plants in Nepal • Early 1960s, • From 1960 to 1990 • From 1990 to 2000 • From 2000 onwards 3.4 Different steps of domestication

	• Assessment of existing genetic resources from collection of botanical garden, germplasm center, herbal farms, etc • Identification of potential useful types • Assessing ease of experimental manipulation • Determining the ecological strategy to survive in nature • Identify mode of reproduction • Assessment of crossing barriers • Assessing the risk of pests and disease • Examining impact on cropping system 3.5 Improvement procedures or procedures for domestication of wild species • Selection breeding • Agronomic studies • Recombination breeding methods • Special breeding methods
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: Good Agricultural Practice (GAP) for MAPs	**Hrs theory : 8**
Describe the general principlesand guidelines of Good Agricultural Practice (GAP) for MAPs	• Introduction • Scope • Terminology (Medicinal plants, aromatic plants, MAPs product, Integrated pest management, Essential oil) • General principles • General guidelines :Plant propagation materials, Site selection, Land preparation, Agro technology, Manuring process, Irrigation, Plant proctection, Harvesting, Primary processing, Transportation, Primary processing site, Grading, Washing, Drying, Secondary processing, Packaging, Storage, Personal hygiene, Documentation and traceability
Unit 5: Good Agricultural and Collection Practice (GACP) of commercially important Medicinal plants	**Hrs theory : 15**
Objectives	**Contents**

Describe Good Agricultural and Collection Practice (GACP) of commercially important MAPs	(i) Introduction of GACP (ii) Importance (iii) Plant identity, distribution, uses (traditional and commercial uses), (iv) Morphological characteristics (v) Collection in wild (vi) Preferred growing conditions (vi) Methods of cultivation (vii) Management ((Irrigation, thinning and weeding, manuring, diseases and pest control) (viii) Harvesting and post harvest procedure (ix) Economics of cultivation (x) Market and value chain (xi) Adulterants *(xii) Conserv*ation status and measures (xiii) Government royality (xiv) Authorized institution of*Asparagus racemosus, Piper longum, Rauvolfia serpentina, Swertia chirayita*
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: Good Agricultural and Collection Practice (GACP) of commercially important Aromatic Plants	**Hrs theory : 15**
Objectives	**Contents**
Describe Good Agricultural and Collection Practice (GACP) of commercially important MAPs	(i) Introduction of GACP (ii) Importance (iii) Plant identity, distribution, uses (traditional and commercial uses), (iv) Morphological characteristics (v) Collection in wild (vi) Preferred growing conditions (vi) Methods of cultivation (vii) Management (Irrigation, thinning and weeding, manuring, diseases and pest control) (viii) Harvesting and post harvest procedure (ix) Economics of cultivation (x) Market and value chain (xi) Adulterants *(xii) Conserv*ation status and measures (xiii) Government royality (xiv) Authorized institution

	of *Cinnamomum tamala, Valeriana jatamansii,Zanthoxylum armatum, Matricaria chamomilla*
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Agro-technology of Medicinal and Aromatic Plants - Practical

Agro-technology of Medicinal and Aromatic Plants (Practical hours: 78)	
Practical 1: Identify government prioritized MAPs for economic development, cultivation and research development	**Practical hours: 10**
Objectives:	**Content:**
• Identify government prioritized MAPs for economic development • Identify government prioritized MAPs for cultivation and research development	• Morphological study of government prioritized MAPs for economic development (Based on herbarium and field study) • Morphological study of government prioritized MAPs for economic development (Based on herbarium specimens or museum specimens and field study)
Evaluation methods: Supervision, field report and written test.	**Teaching / learning activities & resources:** Work in herbal farm or botanical garden or plant research center and GON offices to enhance skills, practice in field
Practical 2: Field practice for government prioritized MAPs for economic development of Nepal	**Practical hours: 16**
Objectives	**Content**
• Identify, collect and prepare a report on government prioritized MAPs (any 5 plant species)economic development, cultivation and research	• Field visit (forest, herbarium, botanical garden, herbarium, pharmacognosy museum, plant research center to identify and collect government prioritized MAPs (Scientific name, family, common name, local name, habit, habitat, altitude, characteristic features)
Evaluation methods: Supervision, field report and written test.	**Teaching / learning activities & resources:** Work in herbal farm or botanical garden or plant research center or MAPs based industries or enterprises and GON offices to enhance skills, practice in field.

Practical 3: Field practice for the process of domestication of Medicinal and Aromatic Plants (MAPs)	**Practical hours: 24**
Objectives	**Content**
Practicethe process of domestication of Medicinal and Aromatic Plants (MAPs)	• Visit herbal farm or botanical garden or plant research center and GON offices. • Demonstrate process of domestication of at least two medicinal and aromatic plants (MAPs)
Evaluation methods: Supervision, field report and written test.	**Teaching / learning activities & resources:** Work in herbal farm or botanical garden or plant research center and GON offices or to enhance skills, practice in field
Practical 4: Enhance knowledge and practical skills on good agricultural and collection practice (GACP) of commercially important MAPs	**Practical hours: 20**
Objectives	**Contents**
• Enhance practical skills on cultivation technique of commercially important MAPs. • Field practiceon good agricultural and collection practice (GACP) on any two commercially important MAPs	• Demonstrate on good agricultural and collection practice (GACP) ofselected GACP developed MAPs (any two). Introduction of GACP (ii) Importance (iii) Plant identity, distribution, uses (traditional and commercial uses), (iv) Morphological characteristics (v) Collection in wild (vi) Preferred growing conditions (vi) Methods of cultivation (vii) Management (….) (viii) Harvesting and post harvest procedure (ix) Economics of cultivation (x) Market and value chain (xi) Adulterants *(xii) Conserv*ation status and measures (xiii) Government royality (xiv) Authorized institution
Evaluation methods: Supervision, field report and written test.	**Teaching / learning activities & resources:** Field visit of herbal farm or botanical garden or plant research center and GON offices to enhance skills, practice in field, attachment with projects, involve in usual activities

Ethnobotany

Total hours: 78 **Full Marks: 50**
Theory: 78

Course Description
This course in ethnobotany is designed to provide students with an understanding of the ethonobotanical applications, co-existence of plants and people, ethnobotanical practices in Nepal and mechanism in place to safeguard these plant based traditional and modern practices for access and benefit sharing. The course emphasize on the role of ethnobotany in shaping the formulation of plant based commodities and Nepal's national and international actions and commitments for documentation, validation and revival of traditional knowledge and practices.

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

1. Sustain interest in ethnobotany and its application related to everyday needs of life.
2. Identify the different aspects of ethnobotany and scope and process of ethnobotany.
3. Describe the science of ethnobotany and expertise, tools and process applied in determining the final product.
4. Demonstrate the skills of colleting, documenting and validating traditional knowledge.
5. Apply the ethnobotanical practices and traditional knowledge in developing a sui-generis system and preparing community protocol.
6. Describe the importance of traditional knowledge based intellectual property rights and mechanism of access and benefit sharing.

Recommended text

7. Bhattarai, D. 2058. Jadibuti Manjari. Suvas printing press, Lalitpur, Nakwahil
8. Chaudhary, R.P. 1998. Biodiversity in Nepal (Status and Conservation).S.Devi, Saharanpur (U.P.), India and Tecpress books, Bangkok, Thailand
9. Convention on Biological Diversity and Nagoya Protocol (http://www.cbd.int)
10. Cotton, C. M. (1996). Ethnobotany: Principles and applications. Chichester, England: John Wiley and Sons
11. Manandhar, N.P. (2002). Plants and People of Nepal. Timber Press, Oregon
12. Rajbhandari, K.R. (2001). Ethnobotany of Nepal. Ethnobotanical Society of Nepal

Course Contents:

Course: Ethnobotany	**Theory: 78 hrs**
Unit 1: Scope, Importance and Field of Ethnobotany	**Theory: 12 hrs**
Objectives	**Contents**
• Describe and identify the different aspects of ethnobotany and its importance in everyday needs • Familiarize themselves with the tools used in ehtnobotanical documentation with examples • Describe the history of ethnobotany and its different braches which shapes the present day ethnobotanical practices	1. Introduction, Definition, Scope and Importance of Ethnobotany 2. Scope of ethnobotanical investigation • Taxonomy • Anthropology • Ethnography • Archaeology • Comparative folklore • Ritual, mythology, cosmology • Ancient history • Religious studies • Medicine • Chemistry • Pharmacology • Field ethnobotany 3. Branches of Ethnobotany • Ethnomycology • Ethnoscience • Ethnomedicine • Ethnopharmacology • Ethnomusicology • Ethnoecology
Unit 2: Ethnobotany and its role in drug formulation	**Theory: 10 hrs**
Objectives	**Contents**
• Describe the science of ethnobotany and expertise used in determining the final product • Understand in brief how to identify useful plant parts, how to extract and isolate useful plant compound and tools used • Describe the importance of scientific validation of traditional knowledge and steps of clinical trial • Understand and explain the role of Singhadurbar Baidha Khana in formulation of plant based drugs and their usage of traditional knowledge	1. Role of botanist, chemist and pharmacist in drug formulation 2. Process of scientific validation and clinical experimental trial 3. Formulation (Definition and examples of ehtnobotanical based plant formulations) 4. A case study of Singha-Durbar Vaidhyakhana (Chandranighantu and its usefulness in drug formulation, Drug formulation by Vaidhyakhana, Plant materials used and its linkage to Traditional knowledge (TK) , Efforts of Baidhkhana to document and protect TK)

Unit 3: Plants and People	**Theory: 16 hrs**
Objectives	**Contents**
• Describe the history of interdependence of plants and people – global history (in brief) and Nepalese history (in detail) • Describe and list at least 2 Nepalese plants which are used in defined areas	1. A brief history of interrelationship between plants and people 2. Description and uses of plants as: • Food (Finger millet, Buckwheat) • Dyes (majitho, okhar) • Fibers and ratans (Bet, Allo) • Gums, resins and latex (sallo, sal) • Oils (Flaxseed, Rapeseed) • Condiments and spices (Tejpat, Timur) • Drinks and beverages (Bael, Dalechuk) • Pharmaceuticals (lauthsalla, Aswagandha) • Cosmetics (Rittha, ghiukumari) • Crop wild relatives (Ban tarul, wild rice) • Food additives (Aduwa, besar)
Unit 4: Plants and Society	**Theory: 16 hrs**
Objectives	**Contents**
• Gain knowledge and be able to explain the ethic richness of Nepal and the history of ethnobotanical exploration in Nepal • Describe the role and importance of culture, religion and indigenous people in documenting, protecting, using and transferring traditional knowledge	1. Ethnic groups in Nepal 2. Status of ethnobotany in Nepal 3. Plants and Culture (jau, Kush, til, srikhand,bamboo) 4. Plants and religion (Rudraksha, Bel, Bar, pipal, Tulsi) 5. Plants and Indigenous People (Chepang, Tamang, Magar, Sherpa, Gurung, Raute, Tharu) – explain traditional uses of at least 5 plants per indigenous people group 6. Plants and Traditional Healers (Amchi, Baidhya, Dhami-Jhankri, traditional tantrik shamanik healers, simple users of herbs and powder)
Unit 5: Safeguarding medicinal plants and traditional knowledge	**Theory: 16 hrs**
Objectives	**Contents**
• Gain insights into the convention of biological diversity, its principles, aims and objectives, basic understanding of Nagoya protocol • Describe the ABS mechanism and works, progress and achievements of Nepal so far • Describe the importance of documenting traditional knowledge, existing databases and different institutions involved	1. Convention on Biological Diversity (CBD) and Nagoya Protocol • Introduction to CBD • Key Principles of CBD • Nagoya Protocol and Access and Benefit Sharing (ABS) • Nepal and ABS 2. Documentation of Traditional Knowledge: A case study of Nepal 2.1. Documentation process of TK 2.2. Role of Actors • Ministry of Forests and Environment

• Understand and describe different terminology used in access and benefit sharing mechanism	• Department of Plant Resources • Central Department of Botany 2.3. Ethnobotanical Database • TKDL (Traditional Knowledge Database Library) • MAPs-Net Nepal 3. Community Protocol and ABS Clearing-house • Prior pre-informed consent (PPIC) • Pre-Informed Consent (PIC) • Mutual Agreed Terms (MAT)
Unit 6: Intellectual Property Rights	**Theory: 08 hrs**
Objectives	**Contents**
• Describe sui-generis system and relevance of intellectual property rights for distribution of benefits • Describe in brief different aspects of bio-prospecting and its importance	1. Intellectual Property Rights (IPRS) and sui-generis • WTO • WIPO, TRIPs • and Nepal • Relevant organizations working in IPR sector • Sui-generis system • Collective Intellectual Property Right • Types of patent • Trade related Bio-prospecting (Introduction and importance)
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources: Class room instruction, Observation, visuals, reading assignment, textbooks, and reference books**

Non-Timber Forest Products (NTFPs)

Total hours: 195 **Full Marks: 100**
Theory: 117
Practical: 78

Course Description:
This course deals about the Non Timber Forest Products (NTFPs). This course provides basic knowledge and skills in identification and management of NTFPs. Introduction, importance, production, harvesting, processing and use of NTFPs will be the main f focus of this course, overall the course makes students able to understand how the NTFPs can be managed.

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

1. Explain the importance and scope of NTFPs.
2. Explain the economic cultivation and processing of NTFPs.
3. Explain the importance of medicinal plants.
4. Select and recommend the uses of harvested /marketed NTFPs
5. Explain the importance of value addition

Recommended Texts:

1. The Indian Forest Utilization, FRI Publication Vol. I & II, Deharadun.
2. The economic value of Non- timber Forest Products in south Asia-JENNEH.DE BEER/IUCN/MELANIE
3. Medicinal and Aromatic Plants-Dr. SS Negi, Dr. Rajeev Kumar Shrivastav and Dr. NS Bisht
4. Manual of Forest Utilisation, S. Chowdhury (2003)
5. Manual of Important NTFPS of Nepal (1998), D.P. Parajuli, A.R. Gyawali and B.M. Shrestha
6. Sustainable Management of NTFPS, M.P. Shiva
7. Kunwar, R.P., (2006). *Non-timber forest products of Nepal* a sustainable management approach

Course Contents

Course: Non Timber Forest Products	**Hrs. theory 117. practical 78**
Unit 1: Introduction of Non-Timber Forest Products(NTFPs)	**Hrs. Theory: 10**
Objectives:	Content:
To introduce NTFPs with definition as well as scope and importance Explain types and categories of NTFPs	Introduction and definition of NTFPs Importance and scope of NTFPs Types/ categories of NTFPs • MAPs • Tans and Dyes • Katha and Cutch • Bamboo and Cane

	• Oil Seed • Leaves, Fibers and Flosses • Lac, Silk and apiculture • Resin and latex • Wild food and fruits, etc
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 2: NTFPs and Livelihood	**Hrs. theory: 6**
Objectives	Contents
To understand the role of NTFPs in livelihood improvement	Definition of Livelihood Role of NTFPs in livelihood improvement Role of NTFPs in employment and incomegeneration
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 3: NTFPs and Sustainable Forest management	**Hrs. theory: 6**
Objectives	Content
To introduce about the concept and practices of bio diversity and sustainable management	Definition of Bio diversity Definition of sustainable forest management Conservation of biodiversity through sustainable forest management
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 4: Ethnobotany	**Hrs. theory: 14**
Objectives	Contents
To introduce about the ethnic values of MAPs and NTFPs	Definition of Ethno botany and its importance Define Ethnic value of MAPS and NTFPs Describe the ethno botanical use of some important MAPs and NTFPs species
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 5: Sustainable Harvesting of NTFPs	**Hrs. theory: 15**
Objectives	Contents

Explain the importance of the sustainable harvesting of NTFPs	Importance of sustainable harvesting of NTFPs and MAPs Existing harvesting practices of NTFPs in Nepal Sustainable harvesting methods/techniques of NTFPs/MAPs
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 6: Resource Assessment	**Hrs. theory: 15**
Objectives	Contents
To clarify the concepts and process of resources assessment	NTFPs Inventory (what and Why) Sampling types and techniques Detail measurement Detail estimation and action
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 7: Resin Collection and Processing	**Hrs. theory: 15**
Objective	Contents
To deliver the knowledge and ideas regarding resin collection and processing	Importance of resin collection in rural income Resin collection practices Improved technology in resin collection Processing of resin to manufacture rosin and turpentine Grading and marketing of rosin and turpentine Uses of rosin and turpentine
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 8: Medicinal and Aromatic Plants	**Hrs. theory: 16**
Objective	Contents
To explain collection and extraction methods and use of commercially valuable MAPs	Importance and scope Domestication potentiality Collection & extraction methods Parts used for medicine of commercially valuable plants Value and uses
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 9: Enterprises and Marketting of NTFPs	**Hrs. theory: 12**

Objective	Contents
Define enterprise and marketing approaches of NTFPs	Enterprise development Micro and Macro Business plan Marketing channel
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, journal and publications.
Unit 10: Value Addition and Post Harvesting Technology	**Hrs theory: 8**
Objective	Contents
To define value addition and post harvesting technology	Define value addition and post harvesting technology Importance of value addition Processing

Non Timber Forest Products (NTFPs) Practical-78 Hrs

Practical 1: Identification of at least 20 important NTFPs species	**Hrs. Practical: 16**
Objectives	*Content*
To identify the NTFP species	Form a different group, assign the task , arrange the tools and identify the NTFPs species
Evaluation Methods: Written tests, field report, assignments and presentation, participation/ field work	Teaching/Learning activities and resources: Field visit, textbooks and reference books, journals and publications selected tools and field practices
Practical 2: Identification of at least 10 Medicinal and Aromatic Plants (MAPs)	**Hrs. Practical: 16**
Objectives	*Content*
To identify the MAPs species	Form a different group, assign the task , arrange the tools and identify the MAPs species
Evaluation Methods: Written tests, field report, assignments and presentation, participation/ field work	Teaching/Learning activities and resources: Field visit, textbooks and reference books, journals and publications selected tools and materials, field practices
Practical 3: Demonstration of the harvesting methods	**Hrs. Practical: 16**
Objectives	*Content*
To demonstrate the harvesting methods of NTFPs	Organize the field day Select at least 5 NTFP species Demonstrate the harvesting methods/techniques in the field
Practical 4: Value addition processing exercise (drying, cleaning, storing etc.)	**Hrs. Practical: 16**

Objectives	*Content*
Evaluation Methods: Written tests, field report, assignments and presentation, participation/ field work	Teaching/Learning activities and resources: Field visit, textbooks and reference books, journals and publications selected tools and materials
Practical 5: Field excursion regarding some NTFP processing and marketing.	**Hrs. Practical: 14**
Objectives	*Content*
To visit the processing companies, observation and sharing	Organize the visit to processing company Make environment for observation and sharing on processing techniques and marketing of the products
Evaluation Methods: Written tests, field report, assignments and presentation, participation/ field work	Teaching/Learning activities and resources: Field visit, textbooks and reference books, journals and publications selected tools and materials

Herbal Products Development

Credit hours: 2+1/week **Full Marks: 100**
Total hours: 128 hours
Theory: 78 hours
Practical: 78 hours

Course Description
This course will provide knowledge about the Consumer Product [Herbal Drinks (Juice and Green tea), cosmetic and toiletry, Nutritive and Dietary] Development by use of Medicinal and Aromatic Plants (MAPs). Herbal products are used in many ways: as medicine, drink, cosmetics, toiletry product, nutritive and dietary products, and its demand is increasing trend. This course will provide knowledge about such product and also to formulation technique. The students will be able to understand the technique of development herbal products.

Course Objectives
The main Objective of this course is - To develop the human resource to contribute in the growth of the herbal manufacturing field with an understanding of product development.
Upon the completion of course the students will be able to

- Develop & decide the appropriate formulation for the herbal products
- Formulate all step of post harvest technique to produce the MAPs Products according the end uses.

Books and References
HPD

1. Herbal / Ayurvedic industry Record of Department of Drug Administration and Department of Ayurveda (GoN, MoH)
2. Directory of Nepal Herbs and Herbal Products Association (NEHHPA)
3. Annual Reports of Export and Import of Trade and Exports Promotion Center (TEPC), GoN, Ministry of Industry, Commerce and Supply)
4. Annual Reports of Department of Plant Resources (GoN, MoFSC)
5. Gaud. Pharmaceutics, 2003, India
6. Gaud and Gupta. Practical Pharmaceutics, 2004, India.
7. Gaud and Gupta. Practical Physical Pharmacy, 2004, India
8. Gaud. Textbook of pharmaceutics, 2004, India
9. Gupta, A. K. Pharmaceutics: Practical manual (Part I & II), 2004, India.
10. Gupta, A. K. Introduction to pharmaceutics-I. , 2004, CBS publisher and distributors, India.
11. Thapa, P, Thapa, B. B. and Budhathoki, U. (2006), Introductory Pharmaceutics volume
12. Physical Pharmacy by Alfred Martin.
13. Bentley's Text Book of Pharmaceutics by E. A. Rawlins.
14. Remington: The Science and Practice of Pharmacy, 20th Edition, Vol I & II.
15. Charak Samhita
16. Introduction to Ayurvedic Pharmaceutics, 2014, Dr. Devendra Joshi & Gita Joshi, Publisher: Chaukhambha Orientalia, ISBN:9788176373166

Course Contents

Course: Herbal Product Development	**Theory: 78 hrs Practical: 78 hrs**
Unit 1: Scope and Importance of Product Development	**Hrs. Theory: 6**
Objectives	Contents
Develop the competitiveness for need assessment of herbal product – with knowledge of herbal product & Herbal base industry present in market,	Introduction and Use pattern of Medicinal and Aromatic Plants Present scenario of MAPs based industry in Nepal Types of consumer products present in Nepalese market
Unit 2: Weight and measures	**Hrs. Theory: 8**
Objectives	Contents
Develop the ability to: Define metrology and to do conversion from one system to another, and	Classify weight and measure and convert from one system to another and one unit to another (British and Metric) Solve the problems related to percentage and ratio strength and dilution and concentration.
Unit 3: Comminution	**Hrs. Theory: 8**
Objectives	Contents
To develop the ability to: Decide the need of size reduction of herbs &Principle of size reduction	Define comminution and describe objectives of size reduction. Describe factors affecting size reduction. Describe principles of size reduction with description of hammer mill, ball mill, fluid energy mill and colloid mill. Classify powders as per official standards.
Unit 4: Mixing and Homogenization	**Hrs. Theory: 8**
Objectives	Contents
Describe the pharmaceutical application of : size separation mixing and working of their respective equipment	Define mixing of Herbs / herbal products (Extract or oil) and mention its pharmaceutical applications Describe liquid-liquid mixing, semisolid – liquid mixing, Semisolid – solid mixing, Solid - liquid mixing and solid - solid mixing Describe the function of the following mixing equipment: Planetary Mixer, Triple Roller Mill, Colloid mill and Double cone mixer.
Unit 5: Filtration and clarification	**Hrs. Theory: 6**
Objectives	Contents
Select filters and describe the different filtration equipment.	Define filtration and explain theory and pharmaceutical applications of filtration

	Discuss filter media and filtration aids in brief Describe factors affecting the selection of filters and describe the application of the following: • Sintered filters. • Filters candles. • Filter press
Unit 6: Heat Process	**Hrs. Theory: 8**
Objectives	Contents
Select the heating system during product Development	Define heat, temperature and heat transfer and describe method of heat transfer Mention the name of different heat processes Define evaporation and explain its pharmaceutical application Describe evaporation still and evaporation pan Explain factors affecting evaporation
Unit 7: Surface, Interfacial Phenomena and Disperse Systems	**Hrs. Theory: 8**
Objectives	Contents
Describe the physicochemical principles of product development and their applications	Define surface and interfacial tension and mention the different methods of measurement. Describe surface-active agents, their physical properties and their pharmaceutical applications. Define colloids and describe their properties. Describe application of colloids in pharmacy.
Unit 8: Introduction to pharmaceutical product preparation and dosage form	**Hrs. Theory: 10**
Objectives	Contents
Classify different pharmaceutical/ other dosage forms and orient with new product delivery systems.	Different preparations and dosage forms Definition and classifications of : Aromatic Water, Cachets, colloids, Creams, Draughts, Dusting Powders, Dentifrices, Elixir, Emulsions, Gargles, Gels, Glycerin, Granules, Effervescent,Granules, Infusions, Inhalations, Jellies, Linctuses, Liniments, Lotions, Mixtures, Mouthwashes, Ointments, Powders,Solutions,Spirits, Sprays, Suspensions, Syrups, Tinctures.
Unit 9: Introduction to Ayurvedic and traditional preparations	**Hrs. Theory: 10**
Objectives	Contents
Describe classification of Ayurvedic traditional and modern preparations	Definition and method of preparation of : Avaleha, Churna, Vati, Taila, Kwath,Ashva/Arista, Ghrita, Pancha vidha

	Kashaya, Kalpana, Arka, Sharbat, Essential oil dilution
Unit 10: Cosmetic and toiletry	**Hrs. Theory:6**
Objectives	Contents
Describe the cosmetic and toiletry preparation	Definition and the method of preparation and factors to be consider during formulation of Soap Cream Lotion Cleaning products
Evaluation Methods: Oral and written test, assignment	Teaching /Learning activities and resources: Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Practical

Product Development Practical	Practical : 78 hrs
Prepare simple Herbal preparations.	1. Carry out simple filtration experiment. (2 hrs)
	2. Carry out the market survey for the type of herbal product in market (Departmental store, Aurvedic drug shop and Traditional Jadibuti shop) and prepare a report on Herbal products present in the market (content of report: Introduction, Objective, Methodology, Findings and conclusion)[10 hrs]
	3. Carry out simple experiment to measure moisture content in given powder material.(2hrs)
	4. Prepare the Herbal tea (Lemongrass, & Ginger) –4 hrs
	5. Prepare the Ashwagandha churna – 4 hrs
	6. prepare and Pack the neem leaf churna - 4 hrs
	7. Prepare the anti rheumatic by given essential oil – 4 hrs
	8. Prepare the mouth wash – 4 hrs
	9. Prepare the Massage oil – 4 hrs
	10. Prepare the Herbal Sarbat (Beal) – 6 hrs
	11. Prepare the Lotion – 6 hrs
	12. Prepare the herbal soap – 6 hrs
	13. Prepare the herbal Cream – 6 hrs
	14. Prepare The herbal body Moisturizer – 6 hrs
	15. Prepare the Triphala Churna – 2 hrs
	16 Prepare the Kushmandavaleha – 6 hrs
	17. Prepare the vasaka extract – 2 hrs

Sustainable Management and Utilization

Credit hours: 2+1 hrs./week **Full Marks: 100**
Total hours: 156
Theory: 78 hrs.
Practical: 78 hrs.

Course Description
This course provides basic knowledge and skill in sustainable management and utilization of medicinal and aromatic plants (MAPs) including sustainable harvesting and practices regarding to MAPs.

Course Objectives
This Course has the following objectives:

- Provide basic information about resources management MAPs
- Generate ideas about sustainable harvesting and practices
- Identify MAPs utilization
- Focus on environmental concerns related to MAPs
- Work as a middle level technician in sustainable management and utilization of MAPs

Books and references:

1. Bhattarai, D.(2058). *Jadibuti Manjari.* Suvas printing press, Lalitpur, Nakwahil
2. Bhattarai, K.R. & Ghimire, M.D. (2063). *Cultivation and sustainable harvesting of commercially important medicinal and aromatic plants of Nepal*, Heritage Research and Development Forum, Nepal.
3. Chaudhary, R.P. (1998). *Biodiversity in Nepal (Status and Conservation)*. S. Devi, Saharanpur (U.P.), India and Tecpress books, Bangkok, Thailand
4. DPR (2067). *Nepalko Aarthik Bikaskalagi Prathamikta Prapta 30 Jadibutiharuko Pahichan Pustika*, Department of Plant Resources, Ministry of Forest and Soil Conservation, Government of Nepal, Kathmandu.
5. DPR (2016). *Medicinal Plants of Nepal*. Department of Plant Resources, Ministry of Forest and Soil Conservation, Governmentof Nepal, Kathmandu.
6. DPR (2074). *Jadibuti Sankalan, Sanrakshan, Sambardhan Bidhi*. Jadibuti Parichaya Mala1-5. Department of Plant Resources, Ministry of Forest and Soil Conservation, Government of Nepal, Kathmandu.
7. DPR (2074). *Jadibuti tatha gairkastha ban paidawar sambandhi talim digdarsan.* Banaspati bivag, Thapathali
8. DoF, Gairkastha ban paidawarko shrot sarbenchhan margadarsan 2069. Ban bivag, Babarmahal
9. Kunwar, R.P., (2006). *Non-timber forest products of Nepal* a sustainable management approach

Course Contents

Course: Sustainable Management and Utilization	**Hrs. Theory: 78 Hrs. Practical : 78**
Unit 1:Resource Management	**Hrs theory : 10**
Objectives	Contents
Explain about the resources and management practices of medicinal plants Describe IUCN listed, CITES listed and government protection list of MAPs of Nepal in	Concept, Plants as natural resources, Medicinal resources, MAPs of Nepal in IUCN listed, CITES listed and government protection list Management practices
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:Sustainable Management	**Hrs theory : 10**
Objectives	Content
Introduce the concept of sustainable management and practices	Concept, Importance and scope Conservation (In-situ and Ex-situ, Community based resource management, Awareness) Collection, Harvesting, Domestication and Cultivation, Good Agriculture Collection Practices(GACP) Sustainable Management • Forest extension and Community forestry • Selective thinning and pruning • Reseeding • Slash and burning • Crop rotation
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: Sustainable harvesting of MAPs	**Hrs Theory: 24**
Objectives	Contents
Describe various harvesting practices of MAPs.	Introduction and importance Sustainable harvesting methods/techniques • Selective harvesting • Intensive harvesting • Rotational harvesting • Block harvesting Existing harvesting practices of MAPs in Nepal Problems in sustainable harvesting
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:MAPs Utilization	**Hrs Theory: 10**
Objectives	**Contents**
Explain use value of MAPs Describe MAPs industries in Nepal	History of Utilization of MAPs Uses and Status of MAPs in Nepal • Utilization as raw material • Utilization as Ayurveda products • Utilization as allopathic medicine • Utilization as aroma therapy • Utilization as essential oil and extract • Utilization as others (industrialization and trade) Industrial use of MAPs (Food, flavors, perfumes, cosmetics, spices and condiments, pharmaceuticals) Major MAPs industries in Nepal A case study of SANCHO (hugely successful product utilizing Nepalese MAP products)
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: MAPs Inventory	**Hrs Theory: 10**
Objectives	Contents
Clarify the concepts and process of resources assessment	Sampling types and techniques Detail measurement Detail estimation and action Sampling methods of MAPs (Random sampling, Systematic random sampling, stratified sampling and transect method)
Evaluation Methods: Written tests, Home assignments and presentation, participation/interaction in class	**Teaching /Learning activities and resources:** Classroom instruction, illustrations, diagrams, visuals, textbooks and referencebooks, journal and publications.
Unit 6:Environmental Concerns	**Hrs Theory: 14**
Objectives	Contents
Explain current scenario of climate change issues , pollution on MAPs	Plants and climate change Land use changes (Land abandonment, Shifting cultivation, Deforestation, degradation,) Effects of waste and pesticide residue on MAPs, Heavy metal contaminants, PRA
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Sustainable Management and Utilization Practical

Course: Sustainable Management and Utilization (Practical hours: 78)	
Practical 1: Visit to the surrounding forest or botanical garden of Nepal	**Hrs Practical: 10**
Objectives	**Contents**
• List major IUCN, CITES and government protection list MAPs of Nepal available in the surrounding forest area. • Explain use of major IUCN, CITES and government protection list MAPs of Nepal available in the surrounding forest area.	• Field visit to the surrounding forest or botanical garden and identify major IUCN, CITES and government protection list MAPs of Nepal • Study of local and commercial use of major IUCN List, CITES appendices and government protection list MAPs of Nepal
Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 2: Listing the major *In-situ* and *Ex-situ* conserved MAPs of Nepal	**Hrs Practical: 10**
Objectives	**Content**
Identify the *In-situ* and *Ex-situ* conservation practices of MAPs	Field visit to the surrounding forest or botanical garden and list the major *In-situ* and *Ex-situ* conserved MAPs
Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 3: Practice for harvesting of MAPs	**Hrs Practical:24**
Objectives	**Contents**
• Demonstrate skills of MAPs harvesting using standard rules and procedures.	• Visit herbal farm or harvesting area of nearby forest • Practice of MAPs harvesting
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books, presentation
Practical 4: Visit to MAPs based industries of Nepal	**Hrs Practical: 14**
Objectives	**Content**
• Identify major MAPs products • Explain the production processes (of major products) of selected MAPs -based industries in Nepal.	• Visit selected MAPs -based industries in Nepal and study the production processes of major products
Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 5: Resources assessment of MAPs	**Hrs Practical: 12**
Objectives	**Contents**
Clarify the process of resources assessment of MAPs	Visit near by forest area and estimate the quantity of MAPs

Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 6: Possibility of MAPs cultivation in abandon land	**Hrs Practical: 10**
Objectives	**Contents**
Identify the abandon or deforested land and study the possibility of MAPs cultivation	Field visit to the near by abandon or deforested land and list the species name of MAPs suitable for cultivation
Evaluation methods: oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** Classroom instruction, illustrations, diagrams, field visits and reference materials.

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 onintroduction 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

Recommended Texts

1. Mahajan B.K. Method of Biostatistics
2. Fundamentals of Geographic Information System – Michael E. Demers
3. GIS for Beginners – ICIMOD
4. Introduction to ArcView GIS – ESRI
5. Getting to know ArcView GIS – ESRI
6. Principles of GIS – Peter A. Burrough and Rachael A. McDonnell

Course Contents

Course: Statistics and Computer	**Hrs. theory 64 Hrs. Practical 64**
Part I: Statistics	**Hrs. theory 32**
Unit 1 *: Bio-Statistics*	**Hrs.theory 10**
1.1: Permutation, combination and binomial Expression	**Hrs.theory 10**
Objectives	Contents
Describe the basic counting principle. Find the permutation of n-objects taken "r" at a time. Find the combination of n-objects taken "r" at a time, When all objects are different. 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 permutation Formula for finding permutation of n- objects taken r at a time Application of formula in related problems Permutation of repeated use of same objects in an arrangement. Meaning of combination. Application of formula in related problem of combination. Binomial theorem (Without proof). Finding general term, middle term and any particular term in the binomail expansion. Binomial coefficients. Proofs of the relation: P (n, r) and c (n, r) Try only No. 1 to 10 of exercise II (1), (2), and (3)
Evaluation methods: written assignments to solve related problems, written examination, oral tests.	**Teaching/Learning activities and resources:** Charts, models, graph boards, diagrams, classroom instruction, and teacher led discussion, demonstration of solutions, and illustration through practical examples, text and reference books.

Unit 2: Elementary Statistics	**Hrs theory 22**
2.1: Probability	**Hrs. theory 4**
Objectives	Contents
Define probability (classical and empirical) Prove and use addition and multiplication theorem of probability. Explain and use binomial probability distribution formula $P(r) = c(n, r)\, p^r q^{n-r}$	Definition of probability (classical and empirical) Proof and use addition and multiplication theorem of probability Explanation and use binomial probability distribution formula $P(r) = c(n, r)\, p^r q^{n-r}$ Exercise XVII (1) and (2) No.1 to 5 only from textbook of grade 11.
Evaluation methods: written assignments , written examination	**Teaching /Learning activities and resources:** Charts, models, graph boards, diagrams classroom instruction, teacher led discussion, demonstration of solution, illustration through practical examples.

2.2: Introduction to statistics (Revision only)	**Hrs theory 2**
Objectives	Contents
Define statistics as given by different writers (Prof. Horace Secrist, Prof. Croxton & Cowden and Prof. Ya-Lu-Chan). State the utility, functions and limitations of statistics. Uses of statistics in various fields.	Definition of statistics by Prof. Horace Secrist, Prof. Croxton & Cowden and Prof. Ya-Lu-Chan. Utility, functions, limitation of statistics and its uses in various fields.
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	• Data tabulation • Data entry • Formatting, editing, charting calculations, formulas

Prepare charts based on entered data	• Saving and opening • Presentation and printing
Evaluation methods: Oral and written test, home assignments, interaction at class, project, seminar	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks, reference books
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.	Classification and tabulation of data. Presentation of data into simple bar diagrams, subdivided bar diagrams, multiple diagrams and percentage bar diagrams.

Draw pie charts and pictograms. Represent data on histograms, frequency polygons, frequency curve and Ogives.	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. practical:2**
Objective	*Content*
Complete typing tutor	Type English Fonts Type Nepali Fonts
Practical 2: Work on MS Word 2006	**Hrs. practical: 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. practical: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. practical: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. practical: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

Third Year

1. **Policies, Trade and Exports of MAPs**
2. **Post Harvest Technology**
3. **Processing Technology**
4. **Quality Management**
5. **Entrepreneurship Development**
6. **Marketing**
7. **Agribusiness Management and Cooperative**
8. **Work Experience Program (WEP)**

Policies, Trade and Export of MAPs

Credit hours: 2+1 hrs./week **Full Marks: 100**
Total hours: 156
Theory: 78 hrs.
Practical: 78 hrs.

Course Description
This course provides basic knowledge and skill in policy, trade and export of medicinal and aromatic plants including different terminologies. The course content will give details about the policies, related acts and regulations in sector of Medicinal and Aromatic Plants. This course gives information about trade of MAPs in national and international market. This course also provide knowledge about requirements in collection, transport, processing and trade.

Course Objectives
This Course has the following Objectives:

- Provide basic information about policies, trade and exportof MAPs.
- Develop skill on collection and transportation of MAPs
- Provide idea about government agencies related to MAPs for various work
- Knowledge transportation and release order from forest agencies
- Know how about the Forest Act, CITES Act and regulations and related guidelines
- National and International market of MAPs and its value-added products
- Describe the process of MAPs trade from field to final destination

Books and references:

1. Forest Act-2075,Government of Nepal
2. Scientific Forest Management Guideline 2071
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4. CITIES Act - 2074
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16. Legal Document related NTFP, MAPs, products by NEPHHA 2075
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18. Joshi, N., Sharma, K., Saud, D.S., 2017, Checklist of CITIES listed Flora of Nepal, Department of Plant Resources, Nepal
19. Nepal Herbs and Herbal Products Association (NEHHPA), 2017, Identification Manual, of Commercial Medicinal and Aromatic Plants of Nepal

Course Contents

Introduction	**Hrs. Theory: 78 Hrs. Practical : 78**
Unit 1: Medicinal and Aromatic Plants and their Products	**Hrstheory:10**
Objectives	**Contents**
Explain different forms of MAPs products and their importance • Define different MAPs commodities with examples • To familiarize about various kind of MAPs and its products for trade • To introduce different major end products from value addition process like flavours, perfumes, pharmaceuticals etc. • Define various aspect of trade components of MAPs at different levels and different routes • Enlist the current status MAPs trade in Nepal and find out the trade volume at different trade level • Introduction different trade routes at different levels from village level to third country like India, Tibet and other countries	General concept of MAPs (introduction and importance) Different forms of MAPs in trade • Raw • Powder • Essential oil • extracts Introduction of MAPs products • Flavours • Perfumes • Spices and condiments • Drinks and beverages • Cosmetics • Pharmaceuticals and nutraceuticals MAPs in trade and different trade routes Trade level (village, roadhead, terai, Indian, third countries) Trade routes (Route to Tibet and route to India, route to other countries)
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Unit 2: Government policy in the MAPs sector	**Hrstheory:10**
Objectives	**Contents**

• Describe different policies formulated by Government of Nepal in MAPs sector • Define vision, mission and objectives of major policies given	Introduction to Policies related to MAPs in Nepal (Mission, Vision, Objectives, Policies and Working plans) • National forest policy 2075 • Herbs and Non-timber Forest Products Development Policy 2061
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 3: Legal requirements for trade of MAPs	**Hrs Theory:16**
Objectives	**Contents**
Explainthe laws governing collection of MAPs • Discuss the process of transportation of MAPs • Describe the agencies and their roles related to trade and export of MAPs • Importance of IEE and EIA for the collection and sustainable harvesting • Familiarize with sealing procedure for trade of Essential oil and other MAPs Product	Brief overview on- • Forest Act and regulation (Traded MAPS list with price) • CITES Act and regulation • Environment Act and regulation (For EIA and IEE requirement) • Plant protection act and regulation, 2063 • National Trade Integration Strategy, 2016 • Sealing working procedure, 2075 of Department of Plant Resources Agencies related to trade and export of MAPs
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: National and International requirement for trade	**Hrs Theory: 8**
Objectives	**Contents**
• Importance of phytosanitary certificate for trade • Explain the different types of facilities for testing MAPs in Nepal • Discuss the various types of tests required to ensure quality MAPs and products • Identify general parameters for national and international trade and export of MAPs • To know about timing for collection and transportation time.	Sanitary and Phyto-sanitary certificate (SPS) Non detrimental Finding (NDF) Types of test and laboratory facility available in Nepal Laboratory tests for trade of MAPs Quality Collection and release permit issued by DFO

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: Role of Forest related agencies in the trade of MAPs	**Hrs Theory:10**
Objective	Content
• Identify different agencies and their role in helping the MAPs collection, transport and trade • Explain how each of these agencies help in different stages of value chain in the MAPs collection and trade cycle • To know about role of DPR as Scientific body for plant and its products identification and certification. • To know about role of Herbarium for identification of plant • To know about role of Natural Products Research Laboratory in testing and certification of plants, essential oil and other facilities • Familiarize with and difference between scientific and management authority	Role of department of plant resources in identification and certification – • Releasing certificate of analysis(as a scientific body) • Releasing certificate of product identification Role of National herbarium • Identification of herbarium species • Identification by anatomy Role of Natural Product Research Laboratory • Certification of essential oil by TLC • Certification of herbs by pharmacognosy • Different kind of parameter testing (as per asked by client) Role of CITES Focal point in plant related trade in Nepal • Management authority • Scientific authority
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 6: Role of TIA and other custom offices for trade of MAPs	**Hrs Theory: 8**
Objective	Content
Identify the major custom and check points in the trade of MAPs Introduction , application process & related documents required for transport and trade of MAPs through these points Describe the role of custom in helping the trade of MAPs	Major custom and check points for MAPs Procedures to be followed for custom clearance MAPs and MAPs products identification at custom point Role of custom in helping trade of MAPs a)TIA b) Other custom offices c) Plant quarantine offices
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.

Unit 7: Technical barriers to trade for MAPs	**Hrs Theory: 8**
Objective	Content
Familiarize with the barriers and challenges of MAPs trade Describe and understand different terminologies and certifications required for trade of MAPs in national and international market	Challenges for MAPs trade COA (Certificate of Analysis), GCP (Good Collection Practice), GACP (Good Agriculture and Collection Practice), Toxicity Test, Material Safety Data sheet (MSDS
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 8: Specific requirements from importing countries	**Hrs Theory: 8**
Objective	Content
• Introduction to terms and terminologies used by various importing countries • Familiarize with the quality standards and parameters required by importing countries • Familiarize with specific requirements for value added product trade	Pesticide test, organic certification, fair trade, ABS (Access to Benefit Sharing), sustainable harvesting HACCP,REACH • Introduction • Importance • Relevancy
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.

Policies, Trade and Export of MAPsPractical Hrs: 78

Policies, Trade and Export of MAPs	**Hrs. Practical : 78**
Practical 1: To List out various Medicinal and Aromatic Plants and their Products for used in domestic market	**Hrs Practical :16**
Objectives	**Contents**
Identify different species of traded MAPs Differentiate various forms of traded MAPs Prepare a report about various kinds of MAPs used in domestic international market	list out the various forms of traded MAPs Raw(any 20) Powder(any10) Essential oil(any 10) Extracts (any 5) Various forms of traded MAPs
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 2: To list out Exportable MAPs from Nepal	**Hrs Practical :10**
Objectives	**Contents**
Identify exportable MAPs and their products Demonstrate raw, processed, semi processed, powered form of MAPs	Exportable MAPs from Nepal Types of MAPs products (Raw, powder, essential oil, extract)
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 3: To collect the data from various agencies related to raw MAPs trade	**Hrs Practical :12**
Objectives	Contents
To make a list of raw MAPs available in your area Plan a visit to district forest office and community forestry office and list the raw MAPs available for trade	Collect the annual export data from nearby district forest office • Introduction • trade value • Trade volume
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 4: Legal requirements for export of MAPs	**Hrs Practical :12**
Objectives	**Contents**
Identify the protected plant species in Nepal	To find out name of plant species that can be exported according to Forest Act (List out any 50 plant

Fill up the forms and format according to Forest Act and CITES Act for collection permit from different agencies Identify the agencies related to MAPs Find out the process related to transportation of MAPs Visit any two agencies related to trade and export of MAPs Make a report	To list out any 3 plants from different annex of CITIES act Agencies related to trade and export MAPs
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 5: National and International requirement for trade	**Hrs Practical : 28**
Objectives	**Contents**
Visit the laboratory facilities for testing MAPs and essential oils in Nepal for quality of MAPs Submit the sample in laboratory for sealing purpose and get the test report Prepare report based on laboratory visit	To plan a visit Laboratory facilities available in Nepal Laboratory tests for trade of MAPs Quality of MAPs and essential oil National and International requirements for trade of MAPs and essential oils Prepare the sample for submitting to laboratory
Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.

Post Harvest Technology

Credit hours: 2+1 hrs/week **Full Marks: 100**
Total hours: 156
Theory: 78 Hrs
Practical: 78 hrs

Course Description
This course will provide knowledge about the Post Harvest Management of Medicinal and Aromatic Plants (MAPs).

Postharvest Management is the stage of crop production immediately following harvest.

- The instant a crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Postharvest treatment largely determines final quality, whether a crop (fresh or dried) is sold for consumption, or used as an ingredient in a produced a consumer product or use to process to produce as an industrial raw material or as an ingredient of formulated consumer products.
- Post-harvest management practices that reduce product loss to spoilage or shrinkage will reduce microbial risks. These include:
    1. Cleaning the product,
    2. Sorting,
    3. Drying or prepared for further processing
    4. Packaging,
    5. Storage
    6. Transportation & distribution

Students will be able to understand major activities and biological changes that reduce the postharvest life of the 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 will be taught.

Course Objectives
This Course has the following Objectives:
To familiarized with the changes in MAPs products i.e., whole or part of plants after harvest.
To develop knowledge to minimize postharvest loss of MAPs products during harvesting, handling and marketing
To develop & decide the appropriate post harvest technique and stage for individual plant product as requirement of next use as consumer product or industrial raw material or processing to produce intermediate product or an ingredient of formulated product, also carefully to extend their shelf life.

Books and References

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2. Series of Good Agriculture Practice (of Medicinal plant species), Published by: of Department of Plant Resources, MoFSC, GoN
3. Definition of process Product developed by Department of Plant Resources, GoN, MoFSC and Nepal Herbs and Herbal Product (NEHHPA)
4. WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants - World Health Organization, Geneva, 2003
5. Ethnobotany and Medicinal Plants; Eds: Bharti PK, Chauhan A.; 2013 (Ist Edition); [Chapter: Post Harvest Techniques for Medicinal and Aromatic Plants -28-45]; ISBN: 978-93-81385-97-5; Ancient Publishing House, Delhi, India
6. Medicinal and Aromatic Plants: Production, Processing, and Pharmaceutics (4 volumes); Amritesh C. Shukla, PhD, DSc**;** Sunita Facknath, PhD; Debashis Mandal, PhD**;** Bernadette Montanari, PhD**;** Published byApple Academic Press Inc. 2019
7. Medicinal and Aromatic Crops: Harvesting, Drying, and Processing 1st Edition, by Serdar Oztekin (Editor), Milan Martinov (Editor)
8. Medicinal and Aromatic Plants - Industrial Profiles (CRC Press On line series): www.crcpress.com/Medicinal-and-Aromatic-Plants---Industrial-Profiles/book-series/CRCMEDAROPLA?a=1&page=4)
9. Medicinal and aromatic plants - agricultural, commercial, ecological, legal, pharmacological and social aspects, (Chapter: Drying of medicinal plants), Publisher: Springer, Editors: Bogers, R J Craker, L E Lange, pp.237-252
10. Post Harvest Handling. 2009. Florkowski, W.J. Prashant Book Agency.
11. Post Harvest Management of Horticultural Produce: Recent Trends. 2009. R.T. Patil. Prashant Book Agency.
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13. Chadha KL et al. (Eds.). 1993-95.Advances in Horticulture. Vol. IX.
14. Plantation Crops and Spices. Malhotra Publishing House, New Delhi.
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16. Paine FA. 1987. Modern Processing, Packaging and Distributions Systems for Food. AVI Publ.
17. Peter KV. (Ed.). 2001. Handbook of Herbs and Spices. Vols.I-III. Wood Head Publishing Co., UK & CRC, USA.
18. Sudheer KP & Indira V. 2008. Post-Harvest Technology of Horticultural Crops. Horticulture Science Series. New India Publ. Agency.

Course Contents

Course: Post Harvest Technology	**Theory: 78 hrs, Practical: 78 hrs**
Unit 1: Scope and Importance of postharvest technology	**Theory: 14 hrs**
Objectives	**Contents**
To develop the ability to: • Define post harvest technology and its importance and objectives; • Explain the causes of post harvest losses and the prevention measures; • Carryout post harvest loss assessment; and • Determine the factors affecting the post harvest life and quality aspects.	1. Introduction, Definition, Scope and Importance of Postharvest Technology, 2. Primary and secondary processing - Definition and example, stages of processing for final product (consumer product / or intermediate extracts, powders as industrial raw materials) 3. Causes of post harvest losses, physiological changes (due to moisture, humidity, temperature, storing), and prevention measures 4. Factors affecting quality of Medicinal & Aromatic and Plant products- correlate with next or end use
Unit 2: Post-harvest handling technique, types of equipments required	**Theory: 26 hrs**
Objectives	**Contents**
To develop the capability for performing the post harvest work of Medicinal & Aromatic Plants	1. Definition, need, reason and methods and types of o Cleaning, o Sieving, o Sorting (on the basis of size, colour and chemical content), o Drying (general, Shed, Sun, Solar, Oven) o Comminution and basis of size o Grading, o Powdering bulk and consumer size) o Packaging, o Storing, o Transportation and distributionwith equipments and materials needed for the specific methods. 2. Selection criteria for post harvest work/ steps of individual plant species and products o Aromatic plants species - which used to as fresh for processing of essential oil o Aromatic plants – which are used as dried material for processing of oil or other formulation o Non Aromatic medicinal plant

	3. Storage system and minimum requirement of storage warehouse 4. Major factors influencing the quality of MAPs products during the storage. 5. Effect of environmental factors during all the steps of post harvest work.
Unit 3: General equipment and handling for Post harvest work	**Theory: 16 hrs**
Objectives	**Contents**
Familiarization with equipment and their handling	1. Design and size of equipments for o Cleaning, o Sieving, o Sorting, o Drying (general, Shed, Sun, Solar, Oven) o Grading o Packaging. 2. Method to develop some equipment by local materials – o Sieve for cleaning and grading o Solar dryer o Drying shed and tray
Unit 4: Post harvest management	**Theory: 22 hrs**
Objectives	**Contents**
To develop competitiveness for post harvest work of Medicinal plants	Post harvest management of individual plant species (all steps of Specific process) Two culinary herbs Ten Medicinal Plants Ten Aromatic plants *(Plant name will be decided after completion of technical courses*)
Evaluation Methods: Oral and written test, assignment	**Teaching /Learning activities and resources:** Class room instruction, Observation, illustration, diagrams, visuals, textbooks, and reference books

Practical

Post Harvest Technology **Practical**	**Practical : 64 hrs**
Unit 1: Identification of laboratory equipments and tools	**Hrs Practical: 6**
Objectives	**Contents**
To develop the ability for judging drying and storing system.	1. Record the room temperature (min and maximum), humidity and atmospheric pressure of 10 days.

Unit 2: Post Harvest work	**Hrs Practical: 58**
Objectives	**Contents**
1. Familiarized with post harvest technique of individual MAPs Product according to their next use (Consumer product / Industrial raw material/ raw material for formulated product)	At least 10 practical each of 4 hrs **= 40 hrs** Perform the Post harvest workof given …….. (Medicinal/aromatic plants material) and calculate the percent of recovery of final product (Cleaning, Sieving, Sorting, communicating, Drying, Grading, Powdering, or as required final product). • 10 Medicinal plants • 10 Aromatic plants of plant Name of plant will be decided after finishing all course)
2. To develop the capability of grading and packaging	• To grade the given plant product on the basis of size and external texture of given herb. – 2hrs • To pack the given herb in consumer size. – 2hrs • To pack the given herb in trader size. – 2hrs
3. Develop some necessary tool by local materials to minimize the cost of production.	• To prepare the washing tray by using the bamboo or wooden strips – 4 hrs • To prepare the drying tray by using the bamboo or wooden strips – 4 hrs • To design the solar dryer (by using the Cardboard, pipes, colour paper, polythene. – 4 hrs
4. Project work: To develop the capability for Designing the warehouse for post harvest work Medicinal plants	To Prepare a Project To Develop Warehouse for Post harvest work of Medicinal and Aromatic Plants (Project content: Introduction, Objective, Layout design, Material and Method, Machinery and equipment, Civil work, Budget and schedule. –**14 hrs**

Processing Technology

Credit hours: 2+1 hrs/week **Full Marks: 100**
Total hours: 156
Theory: 78 hrs
Practical: 78 hrs

Course Description
This course provides basic knowledge in processing techniques of medicinal and aromatic plants including different terminologies regarding to medicinal and aromatic plants, the constituents found in the herbs and their uses. It also provides information and explains about separation and isolation techniques of chemical constituents present in the medicinal and aromatic plants.

Course Objectives
This Course has the following objectives:

- Provide basic information about processing techniques of MAPs.
- Demonstrate the techniques for drying and storage of MAPs.
- Identify the techniques of essential oil extraction and their utilization.
- Demonstrate the method of extraction of various medicinal plants.
- Compare the separation and isolation techniques of extracts and classify the MAPs on the basis of active components.
- Generate ideas of self-employment by MAPs processing and extraction.
- Provide technical service to private and government industries/offices related to MAPs.

Books and references:

1. Essential oil of Nepal, S.R., Adhikary, 2018, Department of Plant Resources.
2. वनस्पति विभाग, २०६७, *नेपालको आर्थिकविकासका लागि प्राथमिकता प्राप्त ३० जडिबुटीहरुको पहिचान पुस्तीका*,
3. भट्टराई, ध्रुवराज, २०५८, *जडिबुटी मञ्जरी*, सुभाषप्रिन्टिङ्गप्रेस, ललितपुर
4. Sharma, B.K. *Instrumental Methods of Chemical Analysis*
5. Organic spectroscopy by Y.R Sharma
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10. Sukhdev Swami Handa, Suman Preet Singh Khanuja, Gennaro Longo, Dev Dutt Rakesh. 2008.
11. Extraction technologies for medicinal and aromatic plants, International centre for science and high technology
12. Tiwari P., Bimlesh Kumar, Mandeep Kaur, Gurpreet Kaur, Harleen Kaur, Internationale Pharmceutica Sciencia, *Jan-March 2011, Vol. 1, Issue 1, Available online* http://www.ipharmsciencia.com, Department of Pharmaceutical Sciences, Lovely School of Pharmaceutical Sciences, Phagwara, Punjab
13. Phytochemical Analysis, C.I. Cueli
14. वनस्पति विभाग ,२०७४ ,जडिबुटी तथा गैरकाष्ठ वन पैदावार सम्बन्धी तालिम दिग्दर्शन

Course Contents

Processing Techniques	**Hrs. Theory:78 Hrs. Practical : 78**
Unit-1 Indrooduction to Processing	**Hrs theory : 10**
Objectives	**Contents**
Explain the meaning of processing and its importance Define the terms value addition, grading, foreign matter, Discuss preliminary steps of processing with examples Explain the terms medicinal plants, aromatic plants, plants used for spices, colouring agents, bitter plants, flavors, fragrances, neutraceuticals, cosmetics .	Terminologies • medicinal plants • aromatic plants • active ingredients • spices • colouring agents • bitter plants • flavors • fragrances • neutraceuticals • Cosmetics Introduction of processing • importance of processing • value addition • benefits of value addition Preliminary steps of processing • Cleaning • Size reduction • grading • separation of foreign matter
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 Drying of MAPs	**Hrs theory : 4**
Objectives	**Contents**
Define drying and explain importance of drying before the processing of MAPs Explain about the effect of moisture due to which MAPs undergo deterioration, produces germs, pests, etc. solar dry, heat dry, shed dry	• General concept of Drying • Importance of drying • Effect of moisture • Advantages • Methods of drying • Traditional methodologies of drying • Modern methods of drying
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit- 3 Storage of Maps	**Hrs theory : 3 Hrs**
Objectives	**Contents**
Discuss the importance of storage Explain general methods of storage of MAPs	• General concept of storage • Importance • Advantages

Describe common and traditional methods of storage of MAPs before processing	• general methods • Specific methods of storage with examples • Traditional methodologies of storage of MAPs
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit-4 Extraction of essential oil	**Hrs theory : 15**
Objectives	**Contents**
Explain the terminologies related to essential oil extraction Describe the methods of essential oil extraction in lab scale and industrial scale Discuss the equipment used in both lab as well as industrial scale for the extraction of essential oil Explain the purification and storage of extracted essential oil	Definition of Essential oil Use of essential oil Essential oil extraction Methods of extraction of essential oil Hydro distillation • Water distillation • Steam-water distillation • Steam distillation Fat extraction Solvent extraction Purification of essential oil Storage of essential oil Laboratory scale of extraction of essential oil Industrial scale of extraction of essential oil
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 Extraction of MAPs	**Hrs theory : 15**
Objectives	**Contents**
Explain the terminologies related to extraction Describe the various methods of extraction process Illustrate the solvents used for the extraction of medicinal plants Discuss the equipment used in both lab as well as industrial scale for the extraction of medicinal plants Explain the purification and storage of extracts	Definition of extract Process of extraction • Maceration • Infusion • Digestion • Decoction • Percolation • Hot continuous extraction (Soxhlet extraction) • Solvent extraction Solvents used for extraction • Water • Methanol • Ethanol • Hexane Aqueous Alcoholic Extraction by Fermentation

	Industrial scale of extraction of medicinal plants
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. Phytochemical screening	**Hrs Theory 10**
Objectives	**Contents**
Explain the meaning and importance of phytochemical screening Discuss the different terms related to phytochemical screening Explain the phytochemical screening processs for the separation of groups alkaloids, flavanoids and terpenoids with examples	Definition and principle of phytochemical screening, purpose of phytochemical screening, Types of phytochemicals (alkaloids, flavanoids, terpenoids, tannins, polyphenolic compounds, glycosides) Detection of alkaloids • Mayer's Test • Wagner's Test • Dragendroff's Test • Hager's Test Detection of carbohydrates • Molisch's Test • Benedict's Test • Fehling's Test Detection of flavonoids • Alkaline Reagent Test • Lead acetate Test Detection of terpenoids • Copper acetate Test
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. Chromatography	**Hrs Theory 18**
Objectives	**Contents**
Explain about chromatography with principle Introduce and discuss about the types of chromatography and its use in identification and certification of MAPs and its processed products Describe Thin layer chromatography and paper chromatography Explain the principle and use of column, gas chromatography and liquid chromatography	Introduction to chromatography Stationary phase Mobile phase Thin layer chromatography • Introduction • Principle • Methodology • Rf values • Advantages of TLC • Disadvantages of TLC • Applications of TLC Paper chromatography • Introduction • propelling forces • retarding forces

	• methodology • choice of filter paper • preparation of the solution of the sample • application of the sample to the paper • development of the chromatograms • drying the chromatogram • location of the compound by using UV lamp • spraying chemicals and dipping in the chemicals • advantages • disadvantages • applications Column chromatography • Introduction • Packing of column • Adsorbents • methods of packing (wet packing and dry packing) • development of chromatogram • elution • recovery of components from column • application of column chromatography Gas chromatography • Introduction • Theory • Advantages • Disadvantages • applications High performance liquid chromatography (HPLC) • Introduction • Theory • Advantages • applications.
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. Spectroscopy	**Hrs Theory 6**
Objectives	**Contents**
Explain the principle of UV, IR and Mass spectroscopy Discuss their applications in identification of MAPs processed products	Definition and principle of UV, UV-visible, IR and Mass spectroscopy Application in identification of MAPs and its products

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

Processing Techniques Practical

Processing Techniques Practical	**Hrs Practical 78**
Practical 1: Essential oil extraction	**Hrs 22**
Objectives	**Contents**
• Find out the list of apparatus used for the extraction of essential oil. • Extract the essential oil of at least five aromatic plants by hydro distillation method using clevenger apparatus from the plant parts (leaf, fruits, pericarps, rhizomes, twigs, barks).	• Apparatus used for essential oil extraction • Extract essential oil from leaf, flower, fruit, rhizomes, seeds, barks, twigs of aromatic plants (wintergreen, Zanthoxylum armatum, cinnamomum tamala, acorus calamus, lemongrass, mentha, eucalyptus, chamomile, citronella, titepati, jatamasi)
Practical 2: preparation of extract	**Hrs 24**
Objectives	**Contents**
• Prepare the extract of medicinal plants (Chiraito, kurilo, lauthsalla, sarpagandha, ashwagandha, pashanbhed, kutki) using water, methanol, ethanol, hexane solvent	• Water extract preparation • Methanol extract preparation • Ethanol extract preparation • Hexane extract Preparation
Practical 3: Phytochemical Screening	**Hrs 20**
Objectives	**Contents**
• Identify alkaloids, terpenoids and flavanoids. • Divide the medicinal plants on each group taking example of at least 3 plants (Chiraito, kurilo, lauthsalla, sarpagandha, ashwagandha, pashanbhed and kutki).	Identification of medicinal plants on the basis of alkaloids, terpenoids and flavanoids Detection of alkaloids • Mayer's Test • Wagner's Test • Dragendroff's Test • Hager's Test Detection of flavonoids • Alkaline Reagent Test • Lead acetate Test Detection of terpenoids • Copper acetate Test
Practical 4: chromatography	**Hrs 12**
Objectives	**Contents**
• Determine the Rf values of a compound in different solvent system using paper chromatography. • Prepare TLC plate and determine Rf values of a compound in various solvent system.	• Calculation of Rf value using Paper Chromatography • Calculation of Rf value using Thin Layer Chromatography (TLC)

Quality Managements of MAPs

Credit hours: 2+1 hrs/week **Full Marks: 100**
Total hours: 156 hrs
Theory: 78 hrs
Practical: 78 hrs

Course Description
This course provides basic knowledge in Quality of Medicinal and Aromatic plants including different terminologies regarding to Quality of medicinal and aromatic plants, the constituents found in the herbs and their uses. It also will help in understanding the quality required throughout the life cycle of the MAPs and it products. It is going to provide the importance of quality in value and also in transition from wild to domestication of MAPs.

Course Objectives
This Course has the following objectives:

- Provide basic information about Quality of MAPs
- Basic idea on maintaining quality of raw herbs
- Importance of Laboratory for quality issues
- Basic information on Quality Assurance
- Information about parameters to be tested for quality
- Role of Accredited laboratory in quality analysis
- Importance of reference materials for testing/quality control
- Importance of quality in wild MAPs and cultivated MAPs
- Relationship between good quality and good price for MAPs
- Importance of maintaining quality throughout the value chain
- Provide technical service to private and government industries/offices related to MAPs.

Books and references:
Quality Standard of Indian Medicinal Plants, Vol 1-15, Indian Council of Medical Research
Basic Tests for Drug, WHO 1998
MAPs and Essential Oils from Nepal, Lex Van Boeckel, 2018, GIZ Nepal
Essential Oils of Nepal, S.R., Adhikary, 2018, Department of Plant Resources
Bhattarai, K.R. and Ghimire, M.D. (2063).Cultivation and sustainable harvesting of commercially important medicinal and aromatic plants of Nepal. Heritage Research and Development Forum, Nepal.
Bhattarai, D.2058. *Jadibuti Manjari.* Suvas Printing Press, Lalitpur, Nakwahil
Medicinal Plants of Nepal, DPR
GCP Guideline, DPR
Phytochemical Analysis, C.I. Cueli,
वनस्पति विभाग, २०७४, जडिबुटी तथा गैरकाष्ठ वन पैदावार सम्बन्धी तालिम दिग्दर्शन

Course Contents

Quality of MAPs	Hrs. Theory : 78 Hrs. Practical : 78
Unit- 1 Concept of Quality	**Hrs theory:6hrs**
Objectives	Contents
Define quality and its importance Explain the concept of quality of MAPs throughout the value chain Explain significance and importance of quality of MAPs Define different types of standards that can be applied to various MAPs and their products	Definition of Quality General concept of quality Significance of quality in MAPs Importance of quality in MAPs Standards related to quality of MAPs
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit-2 Quality of Raw Material	**Hrs theory :10hrs**
Objectives	Contents
Explain about raw material of MAPs Describe Quality parameters of raw material Describe how various parameters affect the quality of raw herbs Explain the external factors affecting quality of raw MAPs Discuss about the Concept and importance of each parameter Define adulteration and its effect in quality of MAPs	Definition of raw materials Quality parameters for raw herbs Factors affecting quality of raw material • Moisture • Drying • Total ash • acid insoluble ash • grading • foreign matter • percentage of essential oil • microbial contamination • antimicrobial activity • heavy metal contamination • Adulteration in raw MAPs with examples
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. Quality of Essential Oil	**Hrs Theory: 12hrs**
Objectives	Contents

Define what is essential oil Explain about the physicochemical parameter related to essential oil which determine its quality Knowledge about each parameter and their value for quality test Interpret the physicochemical parameter to determine the quality of essential oil	Definition of essential oil Physicochemical parameter 1. Optical Rotation 2. Specific Gravity 3. Refractive Index 4. Acid value 5. Ester Value after acetylation 6. Flash point 7. Boiling Point 8. GC Profiling
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. Quality of Specific Essential Oil based on major constituents	**Hrs Theory:20hrs**
Objectives	Contents
Explain about major constituents present in the essential oil Discuss about the importance of major chemical constituents and their uses Describe the major and important constituent present in the essential oil	Quality of Zanthoxylum oil Quality of Wintergreen oil Quality of Lemongrass oil Quality of Mentha oil Quality of Eucalyptus oil Quality of Chamomile oil Quality of Cinnamon oil Quality of Spikenard (Jatamansi) oil Quality of Citronella oil Quality of Vetiver oil
Unit 5. Quality of Extracts	Hrs Theory: 10 hrs
Objective	Contents
Define extract and the process involved Describe the solvent (water, methanol, ethanol, hexane) used and their quality in the extraction process Identify the major constituents found in the given extracts (turmeric, taxus, chiraita, ashwagandha, kurilo)	Concept of Extract Quality of solvent for the extraction process Quality of turmeric extract Quality of taxus extract Quality of chiraita extract Quality of ashwagandha extract Quality of kurilo extract
Unit 6. Laboratory for Quality Testing	Hrs Theory: 6hrs
Objectives	Contents
Define Laboratoryand its type Discuss equipment used in MAPs related laboratory	Introduction to Laboratory Types of Laboratory (Government, Institutional, Private, Industrial) Equipment needed to MAPs testing

Describe laboratory accreditation and its importance in quality result Introduce the term inter laboratory comparison and its importance in quality control of lab	Introduction to Laboratory accreditation Importance of accredited laboratory Quality Assurance, Quality control Inter Laboratory Comparison
Unit 7. Quality Management System in Laboratory	Hrs: 8 hrs
Objective	Content
Define Quality Management System and its application Introduce ISO17025:2017 and explain Personnel, equipment, selection of test methods, reporting the results Describe Good Laboratory Practice and Good Manufacturing Practice and its importance	Definition of Quality Management System (QMS) Application of QMS Introduction toISO/IEC 17025:2017 Personnel, equipment, selection of test methods, reporting the results Good Laboratory Practice (GLP) Good Manufacturing Practice (GMP)
Unit 8. Quality through value chain	Hrs: 6 hrs
Objective	Content
Explain the value chain process and different steps Describe the process of quality maintenance and factors affecting quality at each step of value chain process	Value chain of MAPs Maintain Quality at each step of value chain (seed, seedling, nursery, harvesting, processing, product formulation) Domestication to end use path of MAPs Factors affecting quality of value chain at each level

Practical-Quality of MAPs

Quality of MAPs Practical	**Hrs. Practical : 78**
Practical 1: Quality Parameters	**Hrs theory : 24hrs**
Objectives	**Contents**
Determine the moisture of given raw herbs Determine the total ash of given raw materials Find out amount of essential oils in different aromatic plants in different condition Find out the maximum yield of essential oil	Determine the essential oil percentage of given aromatic plant and plant materials a)Timurfruits b)Sugandhakokila seed c)Lemongrass d)Jatamansi marc e)Tejpat leaf Determine the moisture of given raw herbs Determine the total ash of given raw materials Find out the maximum yield (essential oil) in given time

Practical 2: Quality of Essential oil	**Hrs theory: 24 hrs**
Objectives	**Contents**
Determine the Physicochemical parameter of given essential oil 1. Optical Rotation 2. Specific Gravity 3. Refractive Index 4. Acid value 5. Ester Value after acetylation 6. Flash point 7. Boiling point	Determine the physicochemical parameter of given essential oil 1) Xanthoxyllum oil 2) Wintergreen oil 3) Lemongrass oil 4) Mentha oil, 5) Eucalyptus oil 6) Chamomile oil 7) Cinnamon oil 8) Spikenard (Jatamansi) oil 9) Citronella oil 10) Vetiver oil
Practical 3: Quality based on major constituents extract/essential oil	**Hrs theory: 30hrs**
Objectives	**Contents**
• Determine the major constituents present in the essential oil of given aromatic plants through GC profiling • List out major constituents of each essential oil	Determine the major constituents of given sample based on GC profiling report 1) Xanthoxyllum oil 2) Wintergreen oil 3) Lemongrass oil 4) Mentha oil 5) Eucalyptus oil 6) Chamomile oil 7) Cinnamon oil 8) Spikenard (Jatamansi) oil 9) Citronella oil 10) Vetiver oil

Sales, Marketing and Branding of MAPs

Credit hours: 2+1 hrs./week **Full Marks: 100**
Total hours: 156
Theory: 78 hrs.
Practical: 78 hrs.

Course Description
This course provides basic knowledge in Marketing, Sales and Branding of medicinal and aromatic plants including different terminologies regarding to Marketing, Sales and Branding medicinal and aromatic plants, the constituents found in the herbs and their uses. This course will also help the learner in understanding the marketing and sales process through practical research project. Also it will help the learner understand the potential business of any MAPs and its products.

Course Objectives
This Course has the following objectives:

- Basic knowledge about marketing and marketing process
- Concept of market research and conducting research to find out the marketing potential
- Provide basic information about marketing potential of MAPs
- Basic idea on sales of MAPs in various forms (raw, processed, and value-added products)
- Knowledge on the demand and supply side scenario of MAPs
- Identify the market for MAPs and value-added product nationally and internationally
- Demonstrate the need for branding various value-added products for maximum business potential realization
- Knowledge of various sales techniques to reach across the potential buyer
- Demonstrate the importance of packaging for marketing
- Help in getting practical and firsthand knowledge about Sales and Marketing process
- Provide marketing, sales and branding services to private and government industries related to MAPs

Books and references:

Kotler and Armstrong, Principles of Marketing, Pearson/Prentice - Hall of India
Strauss, Etzel and Walker,E-Marketing, McGraw Hill
GR Agrawal, Fundamentals of Marketing in Nepal, M.K. Publishers
K.D. Koirala, Fundamentals of Marketing, , Buddha Academics, Kathmandu
Shyam K. Shrestha, Fundamentals of Marketing, Asmita Publications, Kathmandu
MAPs and Essential Oils from Nepal a study report by Lex Van Boeckel, Searce Insights Research, GIZ Nepal
DPR 2067 B.S. NepalkoAarthikBikaskalagiPrathamiktaPrapta 30
JadibutiharukoPahichan*Pustika*.Department of Plant Resources, Ministry of Forest and Soil Conservation,Government of Nepal, Kathmandu.
DPR 2007.*Medicinal Plants of Nepal*.Bulletin of the Department of Plant Resources No.28.Department of Plant Resources, Ministry of Forest and Soil Conservation, Government
of Nepal, Kathmandu.

Course Contents

Sales, **Marketing and Branding of MAPs**	**Hrs. Theory: 78 Hrs. Practical : 78**
Unit- 1 Introduction to Marketing Concept	**Hrstheory : 16hrs**
Objectives	Contents
Explain general concept of Marketing Elaborate the essential principles of marketing • Define various emerging trends in marketing • Familiarize with the marketing concept of online and Internet banking • Introduction to Marketing Mix	Definition of marketing Concept of marketing Emerging concept of marketing (social, e-commerce marketing etc.) Internet Marketing and Online Marketing and its significance in current marketing process Marketing mix components (product, place price and promotion) and implication in the market
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 2: Understanding Marketing Environment &Market information	**Hrs Theory: 8 hrs**
Objectives	Contents
• Familiarize with the concept of market environment • Importance and significance of market information • Importance of market research process and use of Internet to collect information	Concept and features of marketing environment Concept and need of market information Marketing research process Use of Internet in collecting information
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 3: Market Segmentation, Targeting and Positioning	**Hrs theory: 8 hrs**
Objective	Content
• Understand the concept of market division • Define market in terms of segments • Describe the concept of types of market and importance of product positioning	Market and Market segmentation Target market, types of market Product positioning concept
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 4: Understanding Buyer's Behaviour	**Hrs theory: 8 hrs**
Objective	Content
• Define Buyer behaviour and buying process	Concept of buyer and buyer behaviour, its importance

• Identifying key factors that determine the buying process and types of buying	Buying decision process, determinant Consumer and Organisational buying decision
Evaluation Methods: Oral and written tests, assignment	**Teaching /Learning activities and resources:** Classroom instruction, observation, illustration, diagrams, visuals, textbooks and reference books.
Unit 5: 4Ps of Marketing Decision	**Hrs theory: 24 hrs**
Objectives	Contents
• Familiarize with 4Ps of marketing and their significance in relation to MAPs • Importance of each P and how it is related to other components of Marketing	Concept and objectives of a) Product - features, strategies, life cycle, branding and logo, packaging etc. b) Pricing - concept, methods, types and strategy c) Promotion - advertising types, tools, promotion mix d) Place/Distribution - methods, channels, conflict and conflict resolution Introduction, decision, types, meaning and requirement
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: Prevailing Marketing Practices in Nepal	**Hrs Theory: 8 hrs**
Objectives	Contents
• Identify and understand different types of Marketing Practices in Nepal • Describe the problems and prospects of marketing in Nepal	Marketing Environment in Nepal Information system, Market research practices Problems and prospects
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: Market potential of MAPs	**Hrs Theory: 6 hrs**
Objectives	Contents
• Explore the market potential of MAPs • Basic consumption trend of MAPs • Explain about the linkages between industries and markets where MAPs is consumed	Basic understanding of various primary, secondary and tertiary products of MAPs The value chain of MAPs Explore and understand the linkage between various end products and MAPs usage

	Importance of value additions role in enhancing profitability in MAPs sales 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.

Marketing Practical

Marketing and Sales Practical	**Hours: 78 hrs**
Practical 1: Identify the Value Addition Potential	**Hrs: 15 hrs**
Objective	Content
Identify different MAPs in the market Select one MAPs product and prepare value addition report from collection to end use	Prepare a detailed list of different types of MAPs in Nepalese market for national and International trade Prepare a detailed report about one product from the perspective of value addition
Evaluation methods: Field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 2: Learn the sales process	**Hrs: 30 hrs**
Objective	Content
Understand and experience the sales process Prepare a report based on the frontline sales experience	Take a product developed by you Conduct door to door sales of the product List the process followed Prepare a report on your experience and consumer feedback
Evaluation methods: Field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 3: Export and Online Market of MAPs and value added products	**Hrs: 15 hrs**
Objective	Content
Explore the Export and Online Sales and marketing of MAPs and value added products 1. Write letter to the forest agencies 2. Department of Forest and Soil conservation 3. Department of Plant Resources 4. Custom Offices 5. Write email to national and International client 6. Upload information on the Internet as per demand	Search and explore the various methods by which MAPs can be marketed online and through social media marketing Send an email enquiry for your product and record the response List the steps and process to be followed by a business to export MAPs and value added products

Evaluation methods: Oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.
Practical 4: Meeting with the stakeholders	**Hrs: 18 hrs**
Objectives	Content
Coordinate with Institute and arrange a field visit with stakeholder Learn about opportunities, cooperation and challenges Meeting minute, agenda, decision	Organize stakeholder meeting related to MAPs Prepare agenda and detailed of the discussion in the meeting, Conduct a meeting and write a report of discussion in the meeting
Evaluation methods: Initiation, planning and organizational skills, oral and written tests and field work activities evaluation	**Teaching / learning activities & resources:** classroom instruction, illustrations, diagrams, field visits and reference materials.

Entrepreneurship Development

Total hours: 195
Theory: 117 **Full Marks: 100**
Practical: 78

Course Description:

This elective course intends to give exposure to students practically in identification of NTFPs and other forest-based enterprise development. At the end of this course, students will be able to identify and prioritize forest based enterprise list including timber and NTFPs in respective areas, prepare a comprehensive enterprise development plan.

Course Objectives:

- Identify major forest products of respective areas i.e. NTFPs, timbers, fibers
- Prepare a list of major forest based enterprises
- Prioritize potential forest based enterprises
- Prepare a comprehensive enterprise development business plan

Text and reference Books

- Improvcing Forest Benefits for the poor: Learning from community- based forest enterprises in Nepal -Dr. Bishnu Hari Pandit, Adrian Albano and Chetan Kumar
- Community -Based tree and Forest Product Entreprises: Market analysis and Development- Prepared by Isabelle Lecup and Ken Nicholson SNV/FAO/RECOFTC/ASNSAB
- Nepalma Tarkari Kheti - DOA HMG/Nepal, Khumaltar
- Cultivation and Utilization of Medicianal and Aromatic Plants - C. K. Atal and B. M. Kapur
- Fruits- Tropical and sub-tropical - T. K. Bose and S. K. Mitra
- Pro-poor Value Chain Development for High Value Products in Mountain Regions: Indian Bay Leaf By ICIMOD

Course:Entrepreneurship Development (Theory hours 117 and practical hours 78)	
Unit 1: Introduction to Enterprise	Hrs. theory 15
Objectives	Content
Define enterprise and list different types of enterprises Discuss about the Feasibility study of an enterprise.	-Definition and different types of enterprise -Feasibility study of an enterprise -Sensitivity analysis -Market analysis -Technical analysis -Case study of a forest based enterprise

Discuss about the components of a Successful business plan from a case study	
Evaluation Methods: Written tests, Home assignments and presentation, participation/ interaction in class.	Teaching/Learning activities and resources: classroom instruction, illustrations, diagrams, visuals, textbooks and reference books, Journals and publications.
Unit-2: Forest based enterprise identification and prioritization	Theory hrs: 15
Objectives:	Content:
• Identify and prioritize forest based enterprises. • Explain the legal procedure of a Timber and Non-timber based enterprise registration. • Discuss about the marketing approach and issues and constraints of marketing • Discuss Issues-based and policy constraints for enterprise development	• Feasibility study of enterprises • Identification and prioritization forest based enterprises • Criteria for enterprise prioritization • Enterprise modalities: issues and constraints of forest based enterprise development, and product marketing • Policy and Legal issues of timber and non-wood forest based enterprises.
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Class room discussion, field visit, practice in field, attachment with projects, involve in usual activities
Unit-3: Value chain of forest products based enterprises	Theory Hrs 20
Objectives: • Explain the value chain of forest based enterprises. • Discuss about the actors of value chain of wood and non-wood enterprises. • Discuss about income and employment generated by value addition process of forest based enterprises. • Environmental impacts of value chain	Content: • Define value chain in forest based enterprises • Mapping the value chain • Actors of value chain • Income and employment generated by value chain in wood and non-wood enterprises • Impacts of value chain in forest based enterprises
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Class room discussion, field visit of wood and non-wood enterprises, practice in field, attachment with projects, involve in usual activities
Unit-4: Business planning	Theory hrs:25

Objectives: • Explain the business plan • Discuss about the elements of business. • Discuss about methods for preparing a business plan of forest based enterprises. • Develop a business plan of a wood or non-wood enterprise.	Content: • Define business plan • Elements or framework of a business plan • Methods for preparing a business plan of forest based enterprises. • Prepare a business plan of a wood or non-wood enterprise.
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Class room discussion, field visit of wood and non-wood enterprises, practice in field, attachment with projects, involve in usual activities
Unit-5: Economic analysis of an enterprise	Theory hrs:25
Objectives	Content
• Explain the basic principle of economic analysis of an enterprise. • Discuss about economic evaluation criteria. • Discuss about profitability analysis • Develop a business plan of a wood or non-wood enterprise.	• Define economic analysis of an enterprise • Profitability analysis • Interest rate • Calculation of values of profitability (net income, net return, gross return, net present value, breakeven point, And internal rate of return etc.
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Class room discussion, field visit of wood and non-wood enterprises, practice in field, attachment with projects, involve in usual activities
Unit-6 Selection of Enterprise, and coordination and linkages for rural enterprise development	Theory hrs: 17
Sub unit 6.1: Selection of an enterprise	Theory hrs:13
Objectives: • Discuss about the enterprise operation process and practices • Discuss about issues and constraints of the selected enterprises.	Content: • Enterprise operation process and practices • Issues and constraints of wood or non-wood enterprises. • How to prepare forest enterprise development guidelines at the local level

Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Class room discussion, field visit of selected wood and non-wood enterprises, practice in field, attachment with projects, involve in usual activities
Sub unit 6.2 : Coordination and linkages	Theory hrs: 4
Objectives: • Discuss about the role coordination and linkages for enterprise development and management	***Content:*** • Define coordination and linkages • Identification of stakeholders(Venn diagram) • Importance of coordination and linkages for enterprise development and management
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Class room discussion, field visit of selected wood and non-wood enterprises, practice in field, attachment with projects, involve in usual activities

Entrepreneurship Development -Practical

Entrepreneurship Development (Practical hours: 78)	
Practical 1: Identify and prioritize MAPs enterprises.	*Practical hours: 10*
Objectives:	*Content:*
• Field practice to identify and prioritize MAPs enterprises.	• Identify and prioritize MAPs enterprises.
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Work in MAPs based enterprise or industry to enhance skills, practice in field
Practical 2: Value chain study in MAPs based enterprise development and management.	Practical hours: 10
Objectives:	Content:
• To discuss and learn about the importance of value chain study in MAPs based enterprise development and management.	• Learn the importance value chain study to operate a MAPs based enterprise.
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Work in MAPs based enterprise or industry to enhance skills, practice in field
Practical 3: Preparation business plan of a MAPs based enterprise	Practical hours: 10
Objectives:	*Content:*
• To learn and practice about business plan preparation and implementation.	• Develop business plan of an enterprises to be operated by MAPs products.

Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Work in MAPs based enterprise or industry to enhance skills, practice in field
Practical 4: Enhance knowledge and practical skills on operating a selected MAPs enterprise and empower on coordination and linkage process	Practical hours: 48
Objectives:	***Content:***
• To enhance knowledge and practical skills on operating a selected MAPs enterprise. • To empower on coordination and linkage process	• Enhance knowledge and practical skills on operating a selected MAPs enterprise. • Enhance skill on coordination and linkages
Evaluation methods: Supervision, field report and written test.	Teaching / learning activities & resources: Work in MAPs based enterprise or industry to enhance skills, practice in field, attachment with projects, involve in usual activities

Agribusiness Management and Cooperative

Credit hours: (3+1) **Full Marks: 100**
Total Hours: 195 hours
Theory: 117 hours
Practical: 78 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.

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.

Course Contents

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; Familiar with input- input relationship such as isoquant, iso- cost line and least cost combination; and	Factor- product: production function, law return Factor –factor: isoquent, iso-cost line, least cost combination 3.1 Product- product: joint, complementary, supplementary and competitive products and opportunity cost

Understand the product- product relationship such as joint, complementary, supplementary, 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**
1. 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

Work Experience Program (WEP)

Total: 90 days **Full marks: 300**

General description

This course intends to provide hands on skills through field observation and work practices in the different fields in Nepal. This field works normally will focus on the area of nursery management of MAPs, herbal farms, cultivation practices, harvesting and processingas well as MAPsbased entrepreneurship development for the period of 3 months (±90 days) in two different modules (Modules-I and II) that to be followed as given below.

Evaluation system

The student's performances will be evaluated based on their training /field work performances in the field, and for that the weightage for the evaluation will be as following:

S.N	Who does evaluate?	Marks
1	Supervisor of the host organization in which the student is placed for WEP	150
2	The Training Institute	50
3	CTEVT or its nominee (external)*	100
	Total	**300**

*** Students are required to secure 60 percent marks in the internal and external examination conducted by CTEVT to pass the course.**

Host Organization is referred as any government and non-government organization having implementation experiences of similar programs for at least 3 years. The host organization should have at least B.Sc. Botany/Chemictry or equivalent graduates to assign as examiner for this purpose of field based students evaluation.

The implementing institution is required to identify the host organization, submit detail field program activity plan to the proposed host organization and get approval/acceptance from them or if necessary, should have formal agreement with them prior to field visit for this module.

A.	**WEP- Module-I:**			
S.N.	**Activities to be performed**	**Duration/ Time**	**Student's evaluation by host organization Total Full Marks - 150**	**Evaluation methods**
1.	Orientation and Preparation about intensive field work (General orientation, information collection (matter and materials)	4 days	-	-
2.	***Intensive Field work on nursery management of MAPs:***	10 days	Full marks- 27 Pass Mark-	Host organization

	Priority area • Identification and observation of Nursery area • Field visit to study existing nurseries • List the necessary materials and tools for seedling production • Prepare a cost estimation for the production of seedlings of MAPs • Find out the sources of seeds & mother plant, • Prepare a nursery bed and soil mixture • Fill up polybags and sowing seeds or transplanting seedling • Plant the seedlings in the private land, public land or in community forestry			can use their own evaluation methods
3.	***Intensive Field work on Herbal farm:*** *Priority area* • Identifyherbal farms in different fields • Observe activities in the herbal farm or botanical garden or plant research center • list out the activities in herbal farms (watering, mulching, weeding, manauring, selective thinning, harvesting • Analyzethe existing land useand cultivation practices • Observe collection, production and processing plan of different species of MAPs in herbal farm	10 days	Full marks- 27 Pass Mark-	Host organization can use their own evaluation methods
4.	***Intensive Field work on community forest :*** *Priority area* • Record MAPs and NTFPs Survey and Resources Information Collection Techniques • Preparation of Map and Area calculation • Identify MAPs and NTFPs Inventory • Collect Socio-economic data of collection techniques in a community forest. (Demand and dependency on MAPs and NTFPs Products- Need, interest, problems and opportunities) • Record the Collection and trade volume, market information and revenue generation of NTFPs and MAPs • Observe the Management practices of NTFPs andMAPsin Community Forestry	08 days	Full marks- 21 Pass Mark-	Host organization can use their own evaluation methods

5.	**Intensive field work on selected ethnic communities** *Priority area* • Identify major ethnic communities • Identify and list major plant species used by traditional healers, dhami/jhankri, tantriks and amchis • Select any one major ethnic group (Rai, Limbu, Majhi, Mooshar,Newar, Tamang, Gurung, Magar, Tharu, Khas, Lama, Sauka, Chepang, Sherpa, Dhimal) and Identify, utilization of at least 25 plants in daily life	08 days	Full marks- 21 Pass Mark-	Host organization can use their own evaluation methods
6.	***Intensive Field work on*** *MAPs* ***based Enterprises (Entrepreneurship Development)*** *Priority area* • Visit forest based micro enterprises (NTFPs, MAPs, paper, handicrafts) and develop the concept and ideas of entrepreneurship development in the field. • Visit NTFPs and MAPs processing centres and study value addition processes • List the process of business prioritization/ feasibility study and preparation of business plan (scheme) of an enterprise. • Process of enterprise registration as per the Nepalese Act • Identify problems, constraints and opportunities in NTFPs and MAPs based enterprise development in local, provenience and central level that visited • Identify products and analyze marketing of NTFPs and MAPs • Identify the role of trade related agencies of MAPs • Find out the Mechanism of export of NTFPs and MAPs as per the existing government rules and regulations	10 days	Full marks- 27 Pass Mark-	Host organization can use their own evaluation methods
7.	***Intensive Field work on*** MAPs ***b***ased industries (Processing and formulation)	10 days	Full marks- 27 Pass Mark-	Host organization can use their

	• Listing the MAPs based small or medium industries • Visit Processing technologies near the community. • Observe the machinery equipment used in primary and secondary processing, extraction, formulation etc. • Observe the advanced equipment used in the industry related to MAPs. • Observe raw materials and their forms used in the industry. • Identify the scope of processed products. • Differenciate between Lab scale and industrial scale of processing of MAPs. • Observe maintaining the quality of raw materials, grading, refining etc. • Observe maintaining the quality of processed products, drying of essential oil etc. • Observe Packaging of products, storage of raw and processed products.			own evaluation methods
	Sub total	**± 60 Days**		
B.	***WEP-Module-II:***			
1.	*Literature review and secondary information collection on CF, W/L mgt, soil; conservation and enterprises*	3 days	-	-
2.	Field data compilation/analysis and draft report preparation	5 days	-	-
3.	Report submission to college supervisor for correction and feed backs	10 days		
4.	Field report presentation practice (40 students) (8 x 5 days = 40)	5 days	-	-
5.	Report finalization, printing, binding and submission to the college	7 days	-	-
	Sub total	**±** *30 days*	-	-
	Total days (Module-I + Module-II)	**± 90 days (3 months)**		

Experts Involved in Curriculum Development Process

1. Mr. Sanjeeb Kumar Rai, Executive Director, Department of Plant Resources Management, Babarmahal, Kathmandu
2. Prof. Dr. Nanda Bahadur Singh, T.U., Central Department of Zoology, Kirtipur, Kathmandu
3. Dr. Hari Prasad Pokharel, Chairman, Yoga and Naturapathy Committee, Nepal Sanskrit University
4. Ms. Jyoti Joshi, Dy. Executive Director, Department of Plant Resources Management, Babarmahal, Kathmandu
5. Mr. Mohan Dev Joshi, Dy. Executive Director, Department of Plant Resources Management, Babarmahal, Kathmandu
6. Mr. Deepak Lamichhane, Sr. Technical Officer, Department of Plant Resources Management, Babarmahal, Kathmandu
7. Mr. Dharmatma Lal Shreewastab, Ex. Sr. Plant Officer, Department of Plant Resources Management, Babarmahal, Kathmandu
8. Mr. Gobinda Ghimire, Chairman, Nepal Herbs and Herbal Producer Association, Kathmandu
9. Mr. Debendra Dhakal, Sr. Vice Chairperson, Jadibuti Entrepreneurs Association Nepal
10. Mr. Tara Dutta Bhatta, Sr. Scientific Officer, Department of Plant Resources Management, Babarmahal, Kathmandu
11. Dr. Kanti Shrestha, Sr. Scientific Officer, NAST, Kathmandu
12. Dr. Kopila Adhikari, Ayurveda Physician, Ayurveda Hospital, Nardevi, Kathmandu
13. Mr. Subash Khatri, Sr. Research Officer, National Herboriam and Plant Resources Laboratory, Godabari, Lalitpur
14. Prof. Dr. Krishna Kumar Shrestha, Chairman, Ethno Botanical Society of Nepal, Kathmandu
15. Dr. Rajendra Nath Adhikari, Sr. Horticulturist, Department of Agriculture, Lalitpur
16. Prof. Mohan Siwakoti, T.U., Kritipur
17. Mr. Tirtha Bahadur Shrestha, Life Member, Nepal Botanist Academy, Kathmandu
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