

A Syllabus on

**Bachelor of Science in Agriculture
(B. Sc. Ag.)**

Faculty of Agriculture

Far Western University



June 2021

Foreword

The Far Western University (FWU) was established at Bhimdatta Municipality of Kanchanpur district in 2010 through an Act of Parliament as a second largest government funded university in Nepal. Presently, the FWU is running seven faculties covering different academic areas within the fifteen Constituent Colleges scattered in nine districts of Far West Province, including Central Campus formally known as Siddhanath Multiple Campus, Mahendranagar. The Faculty of Agriculture (FoA) though launched only in 2018/19 as one of the technical faculties of FWU, it is progressively stepping towards the achievement of defined goals and objectives of the university strategic plan with the flagship identity. The prime objective of FoA is to provide high level quality education to general pupils on allied branches of agriculture through higher level educational institutions. Enhancement of the quality and standard education on competitive basis as per the national level multi-university concept and making fairer, discipline and result-oriented, and robust academic and educational atmosphere of the country is the next objective of the FoA. Right now, the FoA is running the four years of B Sc Ag program at the premise of Tikapur Multiple Campus (TMC), the virgin hub of Quality Assurance and Accredited (QAA) College, in Tikapur, about 125 km towards south east from the university central office, Mahendranagar

The quality standards of the products of FoA will be judged only after the production of qualitative and quantitative manpower, timeliness in work and responsibility of the faculties and staffs on their output performance, and student's and faculty's competitiveness towards searching of advanced knowledge in the field of agriculture and natural resource management. On this line, FoA from its inception has been striving to fulfill its responsibility of making higher education accessible in the allied field of agriculture to the people of the nation in general and of the Far West Province in particular. To run the effective and quality education in smooth manner, the quality standard of the offered courses should be reframed timely at any qualitative academic institution. Therefore, the courses with newly developed syllabus offered to the various semesters of B Sc Ag level is kept in priority to make it suited to the various departments of agriculture like Ministry of Agriculture and Livestock Development (MoALD), Nepal Agriculture Research Council (NARC), and other national and international institutes/ universities.

*It's my great privilege to share this **revised Syllabus** of FoA, Tikapur, Kailali with the consolidated and updated version for obtaining significant goal and missions of FoA/ FWU. The FoA has got this golden chance to prepare this consolidated course syllabus of B Sc Ag with special advice of the honorable Vice Chancellor, Prof. Dr. Amma Raj Joshi and Register Prof Yagya Raj Pathak. Special thanks are given to Prof Dr. M. D. Sharma, Chairman, Dr. Kiran. P. Bhatta, Member Secretary, other faculty members of Agriculture Subject Committee, and other technical sub-committees for their consistent and generous help in preparing this revised prospectus. The FWU families at Mahendranagar and TMC families at Tikapur are highly acknowledged for their kind and generous help in making this event of B Sc Ag course revision work more supportive. I hope this sort of noble work will be continued for the long.*

Thanks.

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Dr. Basant Acharya (Assistant Professor, Animal Science)	Member
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1. Agronomy & Plant Breeding Working-Group

- Ms. Raksha Sharma Coordinator
- Dr. Anil Pokhrel Member
- Mr. Dipendra K. Ayer Member

2. Animal Science and Aquaculture Working-Group

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3. General/Basic Science Working-Group

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4. Horticulture and Agro-Forestry Working-Group

- Mr. Basanta Raj Bhattarai Coordinator
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5. Plant Protection Working-Group

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6. Social Science Working-Group

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7. Soil Science and Agricultural Engineering Working-Group

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Introduction

Far Western University

General Introduction about the University

The Far Western University (FWU) was established in 2010 through an Act of Parliament as a government-funded university. The central office of the university is located at Bhimdatta Municipality of Kanchanpur district. Besides the central campus, FWU has extended different programs in fifteen constituent campuses in different districts of the Far-West Province. Since its inception, FWU has been striving to become a world-class academic institution by proving its academic excellence, creative innovation and research-based practical education. It aims to fulfill its responsibility of making higher education accessible to the people of this region and beyond.

Objectives of the University

The objective of Far Western University is to provide quality education to general public on Arts, Science, Law, Management, Education, Technical and other vocational subjects; to operate higher level educational institutions through the maximum participation of private sector in higher education in order to enhance quality and standard of education on competitive basis as per multi-university concept and to make academic and educational atmosphere of the country more fair, disciplined and result-oriented.

Faculty of Agriculture

General Introduction

FWU has been providing quality education to the general public and public from the lower quintiles of the population with its affordable programs in different disciplines as well as striving to introduce new courses that are relevant for the overall development of the economy, especially in the Far-West Province. In line with it, since agriculture is the mainstay of more than two-third of the population in this region, it is unquestionable that priority should be given to agricultural education if the economy of the region is to grow. Looking at this scenario, FWU made its mission to expand its program and include agriculture since teaching, research and extension of agriculture is vital for the majority of the population in this region. Agriculture alone could contribute significantly to the economic development of Far-Western Region and hence it is justifiable to start Faculty of Agriculture (FoA).

The Faculty of Agriculture was established in 2075 Shrawan 1 (2018 AD) with its central department inside the premises of Tikapur Multiple Campus (TMC) at Tikapur Municipality, Ward No. 1, Kailali district. The Faculty is headed by the Dean with major responsibility for looking after the policy related issues. The central Department of Agriculture (DoA) is located at Tikapur (TMC) and is headed by the Head of the Department (HoD) with major responsibility of looking after day-to-day management of academic, research and extension affairs. The Agriculture faculty has most of the required subject-teachers, which is increasing with advancement of academic sessions and hence as per the need of the new subject-teachers.

The Department of Agriculture has its own two-storey building accommodating all administrative units, academic classes and labs. Classroom and labs are spacious enough to accommodate designated number of students in it. All the classes are equipped with projector and screen for effective teaching through the use of advanced technologies. The DoA has sufficient land that could be brought under its usage but currently around 8 hectares is being

allocated for practical purpose (field-based practical), including around 3.5-hectare Agricultural Farm and 4.5-hectare Aquaculture Farm and it is ever increasing. The Greenhouse, Poultry and Buffalo sheds are under construction with the financial supports of Far-West provincial Ministries. Since, it is in its preliminary years, the DoA is yet to procure all required machineries and equipment as well as the lab and library setup needs further strengthening. The DoA is also in process of developing a good model farm with demonstration of major field crops, fruits, vegetables, agro-forestry based farming, and different livestock animals.

The Faculty has also prioritized entrepreneurship development so that the graduates not only seek job and employment in the related sector but also start their own agribusinesses to serve as the model for those willing to pursue farming as well as those already farming by taking it as a mere way of life rather than farming for production of food to feed themselves as well as another fellow countryman. The Faculty has also adopted the universally recognized model of agricultural education that included agriculture education, research and extension.

This program was able to attract considerable number of interests in the very year of its establishment without any significant advertisements and the number has been increasing gradually. This shows that there is a huge demand from prospective students.

Education System

Semester System

The FoA/FWU follows semester system of education. There are two semesters in each academic year, tentatively (i) Kartik-Chaitra and (ii) Baisakh-Ashoj; intakes are usually done during Bhadra-Ashoj (August/September) with advertisement for Entrance examination done around Shrawan-Bhadra (July/August) for admission in the Kartik-Chaitra session. One semester covers a period of fifteen weeks for teaching, 3-4 weeks for final examination and 1-2 weeks for practical examination. The academic calendar is prepared in the beginning of academic session by the Faculty Dean in approval from FWU Academic Council and circulated to all the departments/campuses for effective functioning of academic program.

Academic Calendar

The FoA will prepare the Academic Calendar aligning that with the academic calendar of the FWU prior to the start of the academic year. The academic calendar will clearly outline the tentative dates of start of the academic sessions and classes, internal assessments and/or mid-term assessments, vacations, final theory examinations and practical examinations, extra-curricular activities and other such activities.

Course Structure

Currently, the Faculty of Agriculture is only offering a single academic program in Bachelors' level, namely "Bachelor of Science in Agriculture" or B. Sc. Ag., in short. The B. Sc. Ag. courses comprise of eight semesters in total (or four years). The total credit hours in the Bachelor degree course is 166. The final semester comprises Research, Practices and Seminar (a sort of mini-research and/or internship).

There are plans to start masters' level program in the future in number of disciplines of Agriculture.

Admission Requirement

Students with I. Sc. (Basic Science), 10+2 (Science), 3 years Intermediate level course in Agriculture, Animal Sciences or equivalent degree are eligible for admission provided following criteria are met (as of 2078):

1. Securing at least 50% marks or CGPA of 2.4 or C+ grade
2. Studied compulsory English, Chemistry, Biology with full marks of at least 100 marks
3. Studied Mathematics and Physics with full marks of at least 50 marks
4. Securing at least 50% marks in the Entrance Examination conducted by FoA

The selection will be based on merit-basis through an Entrance Examination. The marks obtained in the entrance examination will carry 80% weightage and remaining 20% weightage will be provided on previous academic achievement. In this regard, 10% marks of S.L.C./S.E.E. (or equivalent level) and 10% marks of Intermediate (I. Sc. / 10+2 or equivalent level) will be utilized to derive final marks obtained, which will be used to construct the merit list of students. The FoA will intake 100 students in each academic year through entrance system. However, 10 students nominated by the Governmental Institutions will also be selected, totaling 110 students in each batch.

Course Plan

Each course in-charge teacher will prepare the course plan and provide it to the students in the onset of their academic sessions so that students will be clear about their studies in advance.

Theory Classes

Theory classes will be conducted in the classroom environment. In each class, around 50-55 students will be adjusted. So, there will be at least two sections in each batch. **Mixed method of teaching** will be utilized to deliver the theoretical knowledge with the help of power-point presentations, class-work, group discussions, group-works, assignments, presentations, etc. Theoretical classes will be of one (1) hour each.

Practical Classes

Practical classes could be conducted in either of the classroom, lab or field settings. In each practical classes, around 25-30 students will be adjusted. So, there will be at least four sub-sections in each batch. Any of the suitable method of teaching or combinations thereof will be utilized to deliver the practical understanding of the topics under discussion. Theoretical and methodological teaching, calculations, survey and data collection from the farmers' field, analysis of collected data, lab experiments, field experiments and researches, field works, group works, practical tours and visits, farm visits, etc. will be conducted in this regard. Each practical class will have around 1 hour of theoretical teaching and 1 hour or more of field practical, experiments, numerical exercise, etc. thereby requiring at least 2 hours of teacher's engagement.

Practical Tours

To provide students with practical knowledge, they will be taken to the practical tours and visits. All of such tours requiring long travel to neighboring districts or throughout Nepal will be done **either by the end of 6th or by the onset of 7th semester**. This tour will cover major agricultural research stations and other point of interest from the perspective of gaining practical knowledge

regarding agriculture research and practices being conducted throughout Nepal and will be of several days depending upon the planning to be done by DoA. However, for other practical purposes, short visits nearby the campus or within the districts and its vicinity can be conducted from time to time in the same semester when the respective course is offered. The educational tours are kept mandatory to all students under the supervision of a Faculty In-charge with a satisfactory tour report.

Evaluation Systems

Internal Assessment/ Mid-term Examination

The FoA/FWU follows semester system of examination for evaluation. A total of 40% of full marks in theory in each subject is evaluated internally by the subject teacher through an internal assessment/ mid-term examination. The student must secure 45% marks in the internal assessment to be qualified for final examination. In normal cases, following will be the criteria for evaluation (details on "Working Procedure for the Conduction of Internal Assessment/ Mid-term Examination"):

1. Paper-Based Examination	-	40%
2. Assignment	-	20%
3. Presentation	-	20%
4. Class Performance	-	20%

There won't be any chance examinations in normal situation. However, if valid reasons are provided with evidence and if the student is liable to fail without chance examination, one chance (only for paper-based examination) will be provided to the students. If s/he fails to appear on it too, s/he will be marked "NQ", and will not be qualified to sit for the final examinations. However, once passed, the student need not take another such exam even if s/he fails in the final theory or practical examinations and the same marks obtained in the internal assessment will be carried forward in the next examination cycle.

Semester-End Examination

The Examination Controller's Office of the FWU conducts a separate final theory examination of 60% of the total marks externally through an external system of examination at the end of each semester. A student must secure at least 45% marks to pass the final theory examination in each subject. Students who failed in the final theory examination need to appear in the next final theory examination to be conducted next year or **should follow the FWU Examination rules if any**. However, if s/he had passed in either of the internal examinations or practical examinations or both, s/he need not appear on it only because s/he failed in the final theory examinations.

Practical Examination

The Examination Controller's Office of the FWU conducts a separate final practical examination of 100% marks value through a mixed system of examination. This examination will be conducted by the DoA and the course in-charge will be the internal examiner whereas an external examiner **suited to the subjects** will also be deputed by the Examination Controller's Office for conducting the practical examinations. A student must secure at least 45% marks in the practical examination separately to pass the practical examination in each subject. Students who failed in the practical examination need to appear in the next practical examination to be

conducted next year. However, once passed, the student need not take another such exam even if s/he fails in the final theory examinations and the same marks obtained in the practical examinations will be carried forward in the next examination cycle.

Attendance Requirements

Every student must have at least 80% attendance in each subject to be eligible for appearing in the final examination of each semester. All course in-charge teachers shall submit students' attendance to the Head of the Department after the end of session. Student will be unqualified (NQ or Not Qualified) to sit in the final examinations if the minimum attendance requirement of 80% is not met.

Grading System (Undergraduate Degree)

The students are awarded grade points at the end of each semester based on their in-semester and end-semester examination scores. Final evaluation of the course is carried out on a four-point grading system which is provided in the Table below.

Semester Grade Point Average (SPGA)

Semester Grade Point Average (SPGA) is calculated by multiplying the earned grade value by the number of credits for each course and then dividing the total grade points by the total number of semester credits. To pass the semester, the SGPA must be 2.0 or above at the end of each semester.

Cumulative Grade Point Average (CGPA)

Cumulative Grade Point Average (CGPA) is calculated at the end of the program. For graduates, a student has to maintain a CGPA at least by 1.96 or above.

CGPA Calculation

The overall performance reported by CGPA is a weighted average, calculated as follows:

$$CGPA = (c_1g_1 + c_2g_2 + \dots + c_n g_n) / (c_1 + c_2 + \dots + c_n)$$

Where, c_1, c_2, \dots, c_n denotes credits associated with the course and g_1, g_2, \dots, g_n denotes grade values of the grades earned by the students in the respective courses. The CGPA defines the overall performance category.

Table 1: Grading System

Grade	Grade Point	Interval in Percent
A	4	90 and Above
A ⁻	3.56	85 - 89
B ⁺	3.36	80 - 84
B	3.16	75 - 79
B ⁻	2.96	70 - 74
C ⁺	2.76	65 - 69
C	2.56	60 - 64
C ⁻	2.36	55 - 59
D ⁺	2.16	50 - 54
D	1.96	45 - 49

INC	-	Below 45
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Cost Structure

The following cost structures are applicable from the fiscal year 2077/78 and may be revised over the time as per the decision of the Executive Council of the Far Western University.

Institutional Development Fund

Payment of NPR 150,000 (NPR = Nepalese Rupees) should be done for contribution in the Institutional Development Fund (IDF) by all non-scholarship students. However, for those students under additional quota (10 students nominated by Governmental Institutions) need to pay NPR 300,000 as IDF to the Faculty. However, these will be revised over the time as per the university decision.

Fees and Other Costs

All students need to pay NPR 5,200, a one-time fee, during admission in the first year. In each semester, students need to pay NPR 15,000 (NPR 10,000 for scholarship students) as a tuition fee. These fees will be revised over time as per the University decision. Moreover, examination fees and other fees as per the specific requirements of FoA could be taken in addition to these fees.

Security Deposits

Following security deposits need to be paid during initial admission, which will be returned at the time of graduation unless students are found liable to pay certain amount of money towards respective negligence in using facilities provided by DoA:

1. Library - NPR 1,000
2. Lab - NPR 2,000

Scholarship

The Faculty has considered both regionally and socially weak groups of people as well as talented people, while promoting its higher education. The FoA provides scholarship to 25% of the students based on the merit list and quota. The scholarship students need not need to pay the Institutional Development Fund. The fee structure is also reduced for scholarship students. Currently, following types of scholarship are provided based on results from the entrance examinations:

1. Topper List
 - Girls - 2
 - Boys - 2
2. Regional Quota
 - All nine districts of Far-West Province - 9
 - Backward Region - 1
 - Tikapur Municipality - 2
3. Other Quota
 - Madhesi - 2
 - Dalit - 2
 - Janajati - 2

- Handicapped - 1
- Staff/Teachers (FWU) - 2

Semester-Wise Courses Offered

First Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Fundamentals of Agricultural Economics	AEC121	2	1	3	
2	Fundamentals of Agro-forestry	AGF111	1	1	2	
3	Fundamentals of Agronomy	AGR121	2	1	3	
4	Fundamentals of Animal Science	ASC121	2	1	3	
5	Fundamentals of Biochemistry	BCH121	2	1	3	
6	Fundamentals of Horticulture	HRT121	2	1	3	
7	Fundamentals of Soil Science	SSC121	2	1	3	
8	Rural Sociology and Educational Psychology	AEX121	2	1	3	
Total			15	8	23	

Second Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Agro-Meteorology	AMT211	1	1	2	
2	Farm Management and Resource Economics	AEC221	2	1	3	
3	Field Crop Production - I	AGR221	2	1	3	
4	Fundamentals of Crop Physiology	CPH221	2	1	3	
5	Fundamentals of Genetics	PLB221	2	1	3	
6	Manure, Fertilizer and Nutrient Management	SSC221	2	1	3	
7	Ornamental Horticulture	HRT211	1	1	2	
8	Ruminant Production	ASC211	1	1	2	
Total			13	8	21	

Third Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Agricultural Finance and Cooperation	AEC321	2	1	3	
2	Farm Power and Machinery	AEN311	1	1	2	
3	Field Crop Production - II	AGR321	2	1	3	
4	Fundamentals of Entomology	ENT321	2	1	3	
5	Fundamentals of Ichthyology and Limnology	AQU321	2	1	3	
6	Fundamentals of Microbiology and Biotechnology	MBI321	2	1	3	
7	Fundamentals of Plant Pathology	PPA321	2	1	3	
8	Non-Ruminant Production	ASC311	1	1	2	
9	Vegetable and Spice Crop Production	HRT321	2	1	3	
Total			16	9	25	

Fourth Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Agri-Business Management	AEC420	2	0	2	
2	Agricultural Extension	AEX421	2	1	3	
3	Diseases of Agronomical Crops and their Management	PPA421	2	1	3	
4	Fundamentals of Aquaculture	AQU421	2	1	3	
5	Fundamentals of Plant Breeding	PLB421	2	1	3	
6	Medicinal and Aromatic Plants	AGF411	1	1	2	
7	Principles and Practices of Insect Pest Management	ENT421	2	1	3	
8	Principles and Practices of Seed Production and Technology	AGR421	2	1	3	
9	Soil Physics, Genesis and Classification	SSC411	1	1	2	
Total			16	8	24	

Fifth Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Agricultural Marketing, Trade and Prices	AEC521	2	1	3	
2	Animal Health Management	ASC510	1	0	1	
3	Animal Nutrition and Fodder Production	ASC521	2	1	3	
4	Diseases of Horticultural Crops and their Management	PPA521	2	1	3	
5	Fruit and Plantation Crop Production	HRT521	2	1	3	
6	Insect Pest of Crops and their Management	ENT521	2	1	3	
7	Molecular Approaches in Plant Breeding	PLB521	2	1	3	
8	Principles and Practices of Organic Farming	AGR521	2	1	3	
9	Soil Conservation and Watershed Management	SSC520	2	0	2	
10	Agri-Enterprise Learning and Development	AED501	0	1	1	
Total			17	8	25	

Sixth Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Agricultural Communication	AEX611	1	1	2	
2	Agricultural Statistics and Computer Technology	AST621	2	1	3	
3	Advanced Agronomy, Biodiversity Conservation and NUS	AGR621	2	1	3	
4	Farm Structure and Survey	AEN611	1	1	2	
5	Fundamentals of Dairy Science and Technology	ASC621	2	1	3	
6	Industrial Entomology	ENT611	1	1	2	
7	Project Planning and Evaluation	AEC621	2	1	3	
8	Protected Horticulture	HRT611	1	1	2	
9	Mushroom Cultivation	PPA601	0	1	1	
10	Agri-Enterprise Learning and Development	AED601	0	1	1	
Total			12	10	22	

Seventh Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Environmental Science, Climate Change and Disaster Management	ECD721	2	1	3	
2	Field Crop Improvement	PLB721	2	1	3	
3	Geo-Informatics and Nanotechnology for Precision Farming	SSC711	1	1	2	
4	Post-Harvest Horticulture	HRT721	2	1	3	
5	Principles and Practices of Animal Breeding	ASC721	2	1	3	
6	Principles and Practices of Irrigation	AEN721	2	1	3	
7	Social Mobilization and Community Development	AEX721	2	1	3	
8	Economics of Crop and Animal Production	AEC701	0	1	1	
9	Agri-Enterprise Learning and Development	AED701	0	1	1	
Total			13	9	22	

Eight Semester

S.N.	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1	Research, Practices and Seminar	RPS813	1	3	4	
Total			1	3	4	

Note:

CH-Th: Credit Hour of Theory; CH-Pr: Credit Hour of Practical; CH-Total: Total Credit Hour of the Entire Course

Letter code: Three letters represent the subject code;

Digit code: Three digits represent the study year, and theory and practical credit hours offered in the particular subject, respectively

Subject Wise Courses Offered

Agronomy and Plant Breeding

Agronomy

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Fundamentals of Agronomy	AGR121	2	1	3	
2 nd	Field Crop Production - I	AGR221	2	1	3	
3 rd	Field Crop Production - II	AGR321	2	1	3	
4 th	Principles and Practices of Seed production and Technology	AGR421	2	1	3	
5 th	Principles and Practices of Organic Farming	AGR521	2	1	3	
	Agri-Enterprise Learning and Development *	AED501	0	1	1	
6 th	Advances in Agronomy, Biodiversity Conservation and NUS	AGR621	2	1	3	
	Agri-Enterprise Learning and Development *	AED601	0	1	1	
7 th	Agri-Enterprise Learning and Development *	AED701	0	1	1	
Total			12	7	19	

Note: * Students will have choice to take this course in any of the designated Semesters (5th, 6th or 7th)

Plant Breeding

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st						
2 nd	Fundamentals of Genetics	PLB221	2	1	3	
3 rd						
4 th	Fundamentals of Plant Breeding	PLB421	2	1	3	
5 th	Molecular Approaches in Plant Breeding	PLB521	2	1	3	
6 th						
7 th	Field Crop Improvement	PLB721	2	1	3	
Total			8	4	12	

Animal Science and Aquaculture

Animal Science

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Fundamentals of Animal Science	ASC121	2	1	3	
2 nd	Ruminant Production	ASC211	1	1	2	
3 rd	Non-Ruminant Production	ASC311	1	1	2	
5 th	Animal Health Management	ASC510	1	0	1	
	Animal Nutrition and Fodder Production	ASC521	2	1	3	
	Agri-Enterprise Learning and Development *	AED501	0	1	1	
6 th	Fundamentals of Dairy Science and Technology	ASC621	2	1	3	
	Agri-Enterprise Learning and Development *	AED601	0	1	1	
7 th	Principles and Practices of Animal Breeding	ASC721	2	1	3	
	Agri-Enterprise Learning and Development *	AED701	0	1	1	
Total			11	7	18	

Note: * Students will have choice to take this course in any of the designated Semesters (5th, 6th or 7th)

Aquaculture

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st						
2 nd						
3 rd	Fundamentals of Ichthyology and Limnology	AQU321	2	1	3	
4 th	Fundamentals of Aquaculture	AQU421	2	1	3	
5 th						
6 th						
7 th						
Total			4	2	6	

Basic Science

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Fundamentals of Biochemistry	BCH121	2	1	3	
2 nd	Fundamentals of Crop Physiology	CPH221	2	1	3	
3 rd	Fundamentals of Microbiology and Biotechnology	MBI321	2	1	3	
4 th						
5 th						
6 th	Agricultural Statistics and Computer Technology	AST621	2	1	3	
7 th	Environmental Science, Climate Change and Disaster Management	ECD721	2	1	3	
Total			10	5	15	

Horticulture and Agro-forestry

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Fundamentals of Horticulture	HRT121	2	1	3	
	Fundamentals of Agro-forestry	AGF111	1	1	2	
2 nd	Ornamental Horticulture	HRT211	1	1	2	
3 rd	Vegetable and Spice Crop Production	HRT321	2	1	3	
4 th	Medicinal and Aromatic Plants	AGF411	1	1	2	
5 th	Fruit and Plantation Crop Production	HRT521	2	1	3	
	Agri-Enterprise Learning and Development *	AED501	0	1	1	
6 th	Protected Horticulture	HRT611	1	1	2	
	Agri-Enterprise Learning and Development *	AED601	0	1	1	
7 th	Post-Harvest Horticulture	HRT721	2	1	3	
	Agri-Enterprise Learning and Development *	AED701	0	1	1	
Total			12	9	21	

Note: * Students will have choice to take this course in any of the designated Semesters (5th, 6th or 7th)

**Plant Protection
Entomology**

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st						
2 nd						
3 rd	Fundamentals of Entomology	ENT321	2	1	3	
4 th	Principles and Practices of Insect Pest Management	ENT421	2	1	3	
5 th	Insect Pest of Crops and their Management	ENT521	2	1	3	
6 th	Industrial Entomology	ENT611	1	1	2	
7 th						
Total			7	4	11	

Plant Pathology

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st						
2 nd						
3 rd	Fundamentals of Plant Pathology	PPA321	2	1	3	
4 th	Diseases of Agronomical Crops and their Management	PPA421	2	1	3	
5 th	Diseases of Horticultural Crops and their Management	PPA521	2	1	3	
6 th	Mushroom Cultivation	PPA601	0	1	1	
7 th						
Total			6	4	10	

Social Science

Agricultural Economics and Agri-business Management

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Fundamentals of Agricultural Economics	AEC121	2	1	3	
2 nd	Farm Management and Resource Economics	AEC221	2	1	3	
3 rd	Agricultural Finance and Cooperation	AEC321	2	1	3	
4 th	Agri-Business Management	AEC420	2	0	2	
5 th	Agricultural Marketing, Trade and Prices	AEC521	2	1	3	
6 th	Project Planning and Evaluation	AEC621	2	1	3	
7 th	Economics of Crop and Animal Production	AEC701	0	1	1	
Total			12	6	18	

Agricultural Extension

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Rural Sociology and Educational Psychology	AEX121	2	1	3	
2 nd						
3 rd						
4 th	Agricultural Extension	AEX421	2	1	3	
5 th						
6 th	Agricultural Communication	AEX611	1	1	2	
7 th	Social Mobilization and Community Development	AEX721	2	1	3	
Total			7	4	11	

Soil Science and Agricultural Engineering

Agricultural Engineering

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st						
2 nd	Agro-Meteorology	AMT211	1	1	2	
3 rd	Farm Power and Machinery	AEN311	1	1	2	
4 th						
5 th						
6 th	Farm Structure and Survey	AEN611	1	1	2	
7 th	Principles and Practices of Irrigation	AEN721	2	1	2	
Total			5	4	9	

Soil Science

Semester Offered	Name of the Course	Course Code	CH-Th	CH-Pr	CH-Total	Reference Page
1 st	Fundamentals of Soil Science	SSC121	2	1	3	
2 nd	Manure, Fertilizer and Nutrient Management	SSC221	2	1	3	
3 rd						
4 th	Soil Physics, Genesis and Classification	SSC411	1	1	2	
5 th	Soil Conservation and Watershed Management	SSC520	2	0	2	
6 th						
7 th	Geo-Informatics and Nanotechnology for Precision Farming	SSC711	1	1	2	
Total			8	4	12	

Course Syllabus

Agronomy and Plant Breeding

Agronomy

Course Code	AGR121
Course Title	Fundamentals of Agronomy
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon completion of this course, students will be able to explain the basic principles of agronomy for the successful crop production.

Course Description

An introduction to agriculture and agronomy; Weather and climate; Crop growth and yield; Seed and seed quality; Tillage; Cropping system; Soil fertility management; Weed management, Irrigation and drainage; Crop density and plant ideotypes in relation to successful crop production.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction to agriculture and agronomy	
1.1	Definition of agriculture, its branches, scope of agriculture in Nepal and agriculture practices in Nepal	1
1.2	Problems of Nepalese agriculture, food security, reasons of food insecurity in Nepal; Agronomy and role of an agronomist in solving the food problems	1
1.3	Green Revolution: Pros and Cons of Green Revolution	1
1.4	Classification of crops: Agronomic classification, based on growing seasons and special purpose classification	1
2	Weather and climatic factors affecting crop production	
2.1	Definition of weather, climate, meteorology and agro meteorology, elements of weather and climate; Climate and weather of Nepal	1
2.2	Solar radiation and its effects in crop production	1
2.3	Temperature and its effects in crop production	1
2.4	Precipitation, relative humidity, wind and their effect on crop growth including role of monsoon on Nepalese farming	1

3	Crop growth and yield	
3.1	Definition of crop growth, growth response curve with time and nature of crops, phases of crop growth, measuring the crop growth	1
3.2	Factors affecting crop growth; Leaf and canopy photosynthesis, growth and maintenance respiration, photorespiration, abiotic and biotic stress	1
3.3	Economic and biological yield, harvest index, potential yield, attainable yield, actual yield, and national average yield; Yield gap analysis and ways in closing the yield gaps	1
4	Soil fertility and nutrient management	
4.1	Soil fertility and productivity, essential plant nutrients and their classification, criteria of essentiality of plant nutrients	1
4.2	Constraints of soil fertility and productivity, management of soil productivity; Organic manures and their classification	1
4.3	Bio-fertilizers and their use; Types of chemical fertilizers (nitrogenous, phosphatic, potassium and micro-nutrients)	1
4.4	Factors affecting manure and fertilizer application, time and methods of fertilizer and manure application; Integrated nutrient management	1
5	Seed and sowing	
5.1	Definition of seed, characteristics of quality seeds and its importance, differences between seed and grain production	1
5.2	Seed germination and its types, factors affecting seed germination, seed dormancy, causes of seed dormancy, different classes of seeds	1
6	Tillage	
6.1	Definition, history and objectives of tillage and characteristics of good soil tillage; Types and methods of tillage: primary, secondary and inter-tillage	1
6.2	Tillage implements and their uses; Conventional and conservation tillage with their advantages and disadvantages	1
7	Irrigation and drainage	
7.1	Definition, objectives of irrigation, methods of irrigation: surface, subsurface, drip and sprinkler irrigation with their comparative advantages and disadvantages	1
7.2	Scheduling of irrigation: Soil moisture depletion; IW/CPE; Critical crop growth stage approaches	1
7.3	Water logging and its effects on crop growth and development, definition and importance of drainage, types of drainage	1
8	Weed and its management	
8.1	Definition of weed, benefits of weeds, harmful effects of weeds	1

8.2	Classification of weeds: Life cycle, morphology, root system, nature of stem, dependence on host crop, family, association; Special, mode of weed seed dispersal	1
8.3	Principles of weed management, methods of weed management (preventive, eradication and control methods, integrated method of weed management)	1
9	Cropping systems	
9.1	Definitions: monoculture, cropping pattern, cropping system, farming system, multiple cropping, sequence cropping, intercropping, mixed cropping, relay cropping, multistoried cropping	1
9.2	Requirements of multiple cropping, advantages of multiple cropping; Definition, principles and advantages of crop rotation; Land utilization index (LUI), cropping intensity (CI) and land equivalent ratio (LER)	1
10	Crop density and optimum plant population	
10.1	Plant ideotypes of different crops; Plant density and optimum plant population, relation of plant density to crop yield, factors affecting plant densities, crop geometry	1
11	Rainfed farming and water harvesting	
11.1	Difference between dryland and rainfed farming, importance of rainfed farming in Nepal	1
11.2	Management of soil moisture under moisture stress condition, water harvesting	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Visit to the nearby farm to identify major crops grown by the farmers	1
2	Collection and identification of seed of field crops	1
3	Purity and germination tests of seed	1
4	Calculation of seed rates based on germination and purity tests	1
5	Introduction to the various weather recording instruments	1
6	Identification of different tillage equipment, tools and machinery	1
7	Practice on sowing of field crops	1
8	Identification of weeds and weeding of major field crops	1
9	Identification of common fertilizers used in Nepal	1
10	Calculation of manures & fertilizers for application	1
11	Practice on application of manures & fertilizers in field crops	1
12	Preparation of improved compost to preserve nutrients	1
13	Study of cropping system of nearby farmers	1
14	Maturity judging and harvesting of field crops	1
15	Study of yield attributes and yield estimation of field crops	1
	Total	15

Recommended Reading Materials

1. Acquaah, G. (2015). *Principles of Crop Production: Theory, Techniques and Technology*. India: Pearson Education Inc.
2. De Chandra, G. (2017). *Fundamentals of Agronomy*. New Delhi: Oxford and IBH Publishing Co.
3. Lenka, D. and S. Jena. (2002). *Agronomy for Beginners*. Kalyani Publishers. India
4. Reddy, T.Y. and G.H.S. Reddy. (2016). *Principles of Agronomy*. India: Kalyani Publishers.

Course Code	AGR221 / AGR321
Course Title	Field Crop Production - I / II
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon completion of this course, students will gain scientific knowledge and skills for growing summer season field crops successfully (This course will be offered either in second or third semester depending on the nature of growing season of the crop).
Course Description
Introduction and importance, origin, area, production, productivity, distribution, soil and climatic requirement, constraints and opportunities of production, improved cultural practices: land preparation, nursery raising, seeds and sowing, nutrients, water and weed management, harvesting, threshing, cleaning, drying and storage, and recommended varieties of rice, maize, millet, cotton, sugarcane soybean, sunflower, groundnut, sesame, black gram, green gram, and pigeon pea.

Course Breakdown (Theory)		
SN	Course outline	Lectures
1	Rice cultivation	
1.1	Introduction, importance, origin, area, production, productivity and distribution; Major constraint and opportunity of rice in Nepal	1
1.2	Morphology, growth stages of rice, sub species of sativa: <i>indica</i> , <i>japonica</i> and <i>javanica</i>	1
1.3	Soil and climatic requirements and their effects on rice production; Rice growing seasons in Nepal: Boro, Spring and Rainy season	1
1.4	System of rice culture: Upland (Ghaiya), Transplanted rice (TPR), Dry direct seeded rice (DSR), Wet direct seeded, System of rice intensification (SRI); Recommended rice varieties in Nepal	1
1.5	Methods of raising rice seedlings, land preparation and puddling for seed sowing and transplanting, seed rate, sowing and planting spacing	1
1.6	Nutrient management (green manuring, organic manures, chemical fertilizer application, bio-fertilizers), irrigation management, weed management, mechanism of nitrogen loss from rice field and their prevention	1

1.7	Maturity, harvesting, threshing, cleaning, storage and marketing of rice	1
2	Maize cultivation	
2.1	Introduction, importance, origin, area, production, productivity and distribution, major constraints and opportunities of maize production in Nepal	1
2.2	Soil and climatic requirements, production ecology in Nepal; Recommended or registered maize varieties in Nepal	1
2.3	Cultural Practices: Land preparation, sowing time, seed rate, seed treatments, sowing methods and spacing; importance of winter and spring maize in Nepal	1
2.4	Nutrient management; Water management; Weed management	1
2.5	Maturity, harvesting, threshing, cleaning, drying and storage; Importance of winter and spring maize in Nepal	1
3	Sugarcane cultivation	
3.1	Introduction, importance, origin, area, production, productivity, distribution, major constraints and opportunities of sugarcane production in Nepal	1
3.2	Growth stages of sugarcane, soil and climatic requirement; Characteristics different species of sugarcane	1
3.3	Planting time of sugarcane in Nepal, planting materials, sett selection, preparation and treatments; Planting methods: Flat, Furrow, Ridge and furrow, Trench, Space transplanting (Poly bag seedling transplant) and Ring or Pit method	1
3.4	Fertilizer and manure; Irrigation; Weed management, de-trashing, propping and tying and harvesting	1
3.5	Inter cropping Improved varieties and ratoon management in sugarcane	1
4	Cotton cultivation	
4.1	Introduction, importance, origin, area, production, productivity, distribution, major constraints and opportunities of cotton production in Nepal	1
4.2	Characteristics of cotton species; Soil and climatic requirements; Cotton fiber and its quality; Gossypol	1
4.3	Cultural practices: Seeds and sowing, sowing time, seed rate, spacing, thinning, fertilizer management, weed and irrigation management, topping, defoliation, desiccation, improved varieties and harvesting	1
5	Jute cultivation	
5.1	Origin, history, distribution, production and importance of jute in Nepal; Morphology, growth and development of jute plant	1
5.2	Soil and climate requirement for cultivation; Varieties; Land preparation; Planting spacing; Seed rate; Nutrient management; Irrigation management; Weed management; Quality parameters	1
6	Summer grain legumes (Pigeonpea, Soybean, Blackgram, Greengram and Cowpea) cultivation	
6.1	Origin, history, distribution, production and importance of summer legumes in Nepal	1

6.2	Soil and climate requirement for cultivation of summer legumes	1
6.3	Land preparation; Planting spacing; Seed rate; Nutrient management; Irrigation management; Weed management of summer legumes	1
6.4	Varieties, maturity, harvesting, threshing, cleaning and storage of summer legumes	1
7	Summer oilseed crops (Groundnut, Sesame/ Sunflower) cultivation	
7.1	Origin, history, distribution, production and importance of summer oilseeds in Nepal; Soil and climate requirement for cultivation	1
7.2	Varieties; Land preparation; Planting spacing; Seed rate; Nutrient management; Irrigation management; Weed management; Maturity, harvesting, threshing, cleaning and storage	1
8	Finger millet cultivation	
8.1	Introduction, importance, origin, area, production, productivity and distribution, soil and climatic requirement, major constraints and opportunities of finger millet in Nepal	1
8.2	Cultural practices: Land preparation, seedling raising, sowing/ transplanting time, seed rate, sowing methods, relay cropping with maize, fertilizer, weed and water management, recommended varieties, maturity judging, harvesting, threshing, cleaning and storage	1
	Total	30

Course Breakdown (Practical)		
S.N	Course outline	Lectures
1.	Study of morphology and growth stages of rice	1
2.	Raising seedling in nursery: Wet bed, dry bed, Dapog and modified Dapog methods with their relative advantage and disadvantage	2
3.	Land preparation and transplanting of rice seedling	1
4.	Nitrogen application in rice through Leaf Color Chart (LCC)/ SPAD meter	1
5.	Study of morphology and growth stages of maize	1
6.	Practice on sowing of summer season crops	1
7.	Practice on weed management of summer season crops	1
8.	Study of morphology and growth stages of sugarcane	1
9.	Numerical problems in relation to seed (sett) requirement of sugarcane in various planting methods	1
10.	Land preparation and planting of cotton	1
11.	Study of morphological characteristics, branching and flowering of cotton	1
12.	Maturity judging and harvesting of summer crops	1
13.	Study of yield attributes and estimation of yield of summer crops	1
14.	Visit to farmers field to study grain-legumes in cropping system	1
15.	Yield and Commercial Cane Sugar (CCS) estimation in sugarcane	1
	Total	15

Recommended Reading Materials

1. Acquaaah, G. (2017). *Principles of Crop Production: Theory, Techniques and Technology*. Pearson Education Inc. India.
2. Jeyaraman, S. (2017). *Crops Production and Management*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Joshi, B.K., Bhatta, M.R., Ghimire, K.H., Khanal, M., Gurung, S.B., Dhakal, R. and Sthapit, B.R. (2017). *Released and Promising Crop varieties of Mountain Agriculture in Nepal (1959-2016)*. LI-BIRD, Pokhara, NARC, Kathmandu and Biodiversity International, Pokhara, Nepal.
4. Joshi, M. (1990). *Trainer's Manual No.8. Oilseeds*. Publishers: Manpower Development Project, Kathmandu.
5. Prasad, R. (2002). *Text book of Field Crops Production*. ICAR, New Delhi.
6. Rathore, P.S. (1999). *Techniques and Management of Field Crop Production*. Agrosbios, Jodhpur, India.
7. Regmi, K.R. (1990). *Trainer's Manual No.9. Grain Legumes*. Publishers: Manpower Development Project, Kathmandu.
8. Singh C., Singh, P. and Singh, R. (2019). *Modern Techniques of Raising Field Crops*. Revised Edition. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

Course Code	AGR221 / AGR321
Course Title	Field Crop Production - I / II
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon completion of this course, students will gain scientific knowledge and skills for growing winter season field crops successfully (This course will be offered either in second or third semester depending on the nature of crops and growing season of the crop).
Course Description
Introduction and importance, origin, area, production, productivity, distribution, soil and climatic requirement, constraints and opportunities of production, improved cultural practices: land preparation, seeds and sowing, nutrients, water and weed management, harvesting, threshing, cleaning, drying and storage, and recommended varieties of wheat, barley, buckwheat, potato, lentil, Chickpea, grass- pea, field bean, rapeseed and mustard, and linseed.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Wheat cultivation	
1.1	Introduction, importance, origin, area, production, productivity, distribution, major constraints and opportunities of wheat production in Nepal	1
1.2	Soil and climatic requirements during different growth stages of wheat	1
1.3	Cultural practices: Land preparation, sowing time, sowing methods, seed rate, seed treatments, spacing	1
1.4	Nutrient management; Weed management; Water management	1
1.5	Recommended varieties, maturity judging, harvesting, threshing, cleaning, drying and storage	1
1.6	Rice-wheat system: coverage, factors affecting R-W system; Major issues of R-W system	1

2	Barley and Uwa cultivation	
2.1	Introduction, importance, origin, area, production, productivity, major constraints and opportunities of barley production in Nepal	1
2.2	Soil and climatic requirements and classification of barley; Cultural practices: land preparation, seed and sowing, sowing times, seed rate, spacing, manure and fertilizer, irrigation, and weed management, recommended varieties, harvesting, threshing cleaning, drying and storage	1
2.3	Introduction, importance, characteristic, nutritional value and distribution of naked barley (Uwa) in Nepal, differences between barley and Uwa	1
3	Buckwheat cultivation	
3.1	Introduction, importance, origin, area, production and productivity, major constraints and opportunities of buckwheat production	1
3.2	Soil and climatic requirements, types of buckwheat; Cultural practices: land preparation, seed and sowing, manures and fertilizer, weed control, water management, recommended and promising varieties, harvesting ,threshing and storage	1
4	Potato cultivation	
4.1	Introduction, importance, origin, area, production, productivity, distribution, major constraints and opportunities of potato production in Nepal	1
4.2	Soil and climatic requirements, and growth stages of potato	1
4.3	Seed and sowing: true potato seed verses potato tuber; Requirements of quality seed, seed preparation and seed treatments, and dormancy	1
4.4	Planting time, methods, seed size and rate, spacing, and fertilizer management	1
4.5	Inter-culture, earthing up, and weeding, irrigation management, recommended varieties, harvesting, grading and storage	1
5	Lentil cultivation	
5.1	Introduction, importance, origin, area, production, productivity, distribution and major constraints and opportunities of lentil production in Nepal	1
5.2	Soil and climatic requirements, classification, growth stages, and its place in cropping system	1
5.3	Improved cultural practices: Manures and fertilizer application, seed and sowing, weed control and water management, recommended varieties, harvesting, threshing, cleaning and storage	1

6	Chickpea cultivation	
6.1	Introduction, importance, origin, area, production, productivity, distribution and constraints and opportunities of chickpea production in Nepal	1
6.2	Soil and climatic requirements, and classification of chickpea; Improved cultural practices: land preparation, manures and fertilizer application, seed and sowing, weed and water management, recommended varieties, harvesting, threshing, cleaning and storage	1
7	Grass-pea cultivation	
	Introduction, importance and distribution in Nepal, Anti-nutritional factor and its solution in grass-pea, improved cultural practices of grass pea including relay cropping with rice	1
8	Field Beans (<i>Phaseolus spp.</i>) including “RAJMA” cultivation	
8.1	Introduction, importance, origin, distribution and classification of beans (kidney bean, Lima bean, pole bean including Simi, Ghiu Simi, and Jumli Simi)	1
8.2	Soil and climatic requirements; Improved cultural practices: land preparation, manures and fertilizer application, seed and sowing, weed and water management, recommended varieties, and harvesting	1
9	Rapeseed and mustard cultivation	
9.1	Introduction, importance, origin, area, production, productivity, major constraints and opportunities of rapeseed and mustard in Nepal	1
9.2	Soil and climatic requirements, and classification of kinds of rapeseed and mustard grown in Nepal with their characteristics features	1
9.3	Improved cultural practices: Place in cropping system, land preparation, seed and sowing: time of sowing, seed rate, and spacing, and manures and fertilizer application	1
9.4	Water and weed management, harvesting, threshing, storage and oil quality of rapeseed and mustard	1
10	Linseed cultivation	
10.1	Introduction, importance, origin, and distribution in Nepal, soil and climatic requirements and improved cultural practices of linseed production in Nepal	1
11	Niger seed cultivation	
11.1	Introduction, importance, origin and distribution in Nepal, soil and climatic requirements and improved cultural practices of Niger production in Nepal	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Planting of winter seasonal crops in agronomy farm of the college	1
2	Classification and study of growth stages of wheat crop	1
3	Classification and morphological characteristics of potato	1
4	Classification and growth stages of a legume	1
5	Sowing and study of different growth stages of lentil, chickpea, rajma and grass pea	1
6	Numerical calculation on seed, fertilizers, pesticides requirements of winter crops like wheat, potato, rapeseed and mustard	1
7	Yield attributes and estimation of yield of winter season field crops	
7.1	Legumes and Oilseed crops	1
7.2	Cereals	1
8	Visit to research station/ agronomy farm to understand different researches	1
9	Fertilizer application (method, time, dose and split) in winter crops	1
10	Rhizobium inoculation in legumes	1
11	Layout and sowing of field crops to conduct field experiment	1
12	Data collection from the agronomic experimentation grown with winter crops	1
13	Visit to nearby farmers to study about grain legumes integration in cropping system	1
14	Calculation of cropping intensity, cropping index and land equivalent ratio	1
	Total	15

Recommended Reading Materials

1. Bhomi, B.K. and Pandey, P. R. (1992). *Trainer's Manual No.18. Potatoes*. Publishers: Manpower Development Agriculture Project.
2. Joshi, B.K., Bhatta, M.R., Ghimire, K.H., Khanal, M., Gurung, S.B., Dhakal, R., and Sthapit, B.R. (2017). *Released and Promising Crop Varieties of Mountain Agriculture in Nepal (1959-2016)*. LI-BIRD, Pokhara, NARC, Kathmandu and Biodiversity International, Pokhara, Nepal.
3. Joshi, M. (1988). *Trainer's Manual Wheat*. Publishers: Manpower Development Agriculture Project, Kathmandu.
4. Joshi, M. (1990). *Trainer's Manual No.8. Oilseeds*. Publishers: Manpower Development Project, Kathmandu.
5. Prasad, R (Editor). (2002). *Text book of Field Crops Production*. ICAR, New Delhi.
6. Rajbhandari, B.P. and Bhatta, G. RD (2008). *Food Crops. Agro- Ecology and Modern Agro-Techniques*. HICAST, Kathmandu, Nepal.
7. Rajbhandari, B.P. and Bhatta, G. D. (2009). *Food Crops. Agro- Ecology and Agro-Techniques of Industrial Crops*. HICAST, Kathmandu, Nepal.
8. Rathore, P.S. (1999). *Techniques and Management of Field Crop Production*. Agrosbios, Jodhpur, India.

9. Regmi, K.R. (1990). *Trainer's Manual No .9. Grain Legumes*. Publishers: Manpower Development Project, Kathmandu.
10. Singh, C. (1997). *Modern Techniques of Raising Field Crops*. Oxford and IBH publishing co. Pvt. Ltd., New Delhi.

Course Code	AGR421
Course Title	Principles and Practices of Seed Production and Technology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course	
Upon the completion of this course, the students will understand the principles for successful production of seed of major crops and gain basic skills for producing quality seed.	
Course Description	
Seed, fruit, grain, propagating materials; Seed development process and factor affecting it, seed dormancy, germination and quality seed and factor affecting it, seed longevity; Types of seed and their multiplication techniques; Certification and distribution; National and International organization involved in seed, seed law, farmer's seed and intellectual property right (IPR).	

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Basics of Seed Production	
1.1	Seed and grains; Seed materials; Seed technology; Quality seed; Seed Production history and scope in Nepal	1
1.2	Seed system in Nepal and National Seed Vision (2013-2025)	1
1.3	Different categories of seed; Classes of seed (Nucleus, Breeder, Foundation, Certified, Improved, Truthful labelled Seeds) in Nepal	1
2	Seed Policies and Provisions	
2.1	Seed Act 2045, National Seed Policy 2056, Seed Regulation Act 2069, Seed Certification Directives 2074	1
2.2	Role of Seed Quality Control Centre (SQCC); Central Agriculture Laboratory; Provincial Seed Laboratory; International Seed Testing Association (ISTA)	1
2.3	Varieties release and registration processes in Nepal	1
3	Seed Formation and Development	
3.1	Factors affecting seed growth and development	1
3.2	Floral induction and flower structure, sexual and asexual reproduction	1
3.3	Post fertilization changes in flower, embryo, endosperm and seed-coat development	1
4	Seed Germination and Dormancy	
4.1	Seed germination: types, process, and factors affecting seed germination	1
4.2	Seed dormancy: causes, types and methods of breaking seed dormancy	1
5	Genetic Principles of Quality Seed Production	

5.1	Varietal deterioration, developmental variation, natural crossing	1
5.2	Effect of disease and pests, maintaining varietal purity	1
5.3	Hybrid seed production technologies and GM crops	1
6	Agronomic Principles of Quality Seed Production	
6.1	Recommended domain, variety and land selection, land preparation and fertilizer management	1
6.2	Sources of seed, seed rate and class; Isolation distance and time isolation	1
6.3	Supplementary pollination, rouging, weed management, water management	1
6.4	Disease and pest management	1
7	Field Inspection and Seed Sampling	
7.1	Objectives, general principles and methods of field inspection	1
7.2	Field inspection stages and time in various crops; Lot number and its arrangement in seed store	1
7.3	General principles of seed sampling, types of seed samples; Procedure of seed sampling; Precautions while doing seed sampling	1
8	Seed Certification	
8.1	Objectives, concepts and general principles	1
8.2	Seed certification process in Nepal	1
8.3	Minimum field and seed (lab) standard for seed certification in Nepal	1
9	Seed Testing and Treatment	
9.1	Principles of seed germination; Purity and Moisture test; Methods of seed germination, purity and moisture test; Seed rate calculation based on germination and purity results	1
9.2	Definition of seed vigor, principles of seed viability and moisture test; Seed priming, Inoculation, Disinfestation and Disinfection; Seed treatment: objective, concepts, process and precautions	1
10	Seed Processing, Storage and Marketing	
10.1	Seed crop harvesting, threshing, cleaning, drying	1
10.2	Seed grading principles and procedures	1
10.3	Principles and objectives of seed storage; Seed storage devices/ materials/ houses with their merits and demerits	1
10.4	Post-harvest management of seeds	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of seeds along with the characteristics of various field crops	1

2	Practice on seed germination test in field and in lab	1
3	Practice on seed vigor and viability test	1
4	Practice on seed purity test and seed moisture test	1
5	Seed sampling from the seed store house	1
6	Visit to seed production farm nearby college	1
7	Method of field inspection of the seed crops and practices on filling forms	1
8	Practice of seed cleaning, drying and grading	1
9	Visit to seed processing plant, seed co-operative and seed production farm	1
10	Visit to seed laboratory Sundarpur, Kanchanpur/ Khajura, Banke	1
11	Seed production of a field crop	1
12	Practice on seed treatment, packaging and grading	1
13	Breaking dormancy of different crop seeds	1
14	Identification of seed borne diseases and pathogens	1
15	Practice on roguing of off types and diseased plants in the field	1
	Total	15

Recommended Reading Materials

1. Agrawal, R.L. (2005). *Seed Technology*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Bhattachan, B.K. (2010). *Manual on Principles and Practices of Seed Technology*. Institute of Agriculture and Animal Science, Rampur, Chitwan.
3. Bhattachan, B.K. (2011). *Research Manual of Seed Technology*. Institute of Agriculture and Animal Science, Rampur, Chitwan.
4. Copeland, L.O. and McDonald, M.B. (1985). *Principles of Seed Science and Technology*. Burgess publishing Company, Minneapolis, Minnesota USA.
5. Justice, O.L and Louis, N.B. (1978). *Principles and Practices of Seed Storage*. Agric. Hand Book No 506.
6. LI-BIRD and The Development Fund. (2017). *Farmers' Seed Systems in Nepal: Review of National Legislations*. Pokhara, Nepal.
7. Mirja Hasanuzzaman. (2020). *Agronomic Crops*. Volume 1 Production Technologies. Springer Publication.
8. MoAD. (2014). *National Seed Vision 2013-2025*. Ministry of Agricultural Development. Nepal.
9. Paudel, M.N., Pokhrel, S., Gadai, N., Ferrara, G-Ortiz., KC D., Joshi, P., and Humagain, R. (2013). *An overview of different seed production initiatives in Nepal*. Agronomy Journal of Nepal. Vol 3.

Course Code	AGR521
Course Title	Principles and Practices of Organic Farming
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course	
Upon the completion of this course, the students will be able to understand the underlying principles and practices of organic farming, current practices, provision and policies in this sector, identify key stakeholders, apply organic approach into practice and identify the major organic commodities for cultivation, promotion and management in Nepal.	
Course Description	
Basics of organic farming, Land use in agriculture production; Organic approaches to soil fertility management; Organic approach to weed, disease and pest management; Organic crop and animal production technologies; Various models of organic farming adopted worldwide and in Nepal; Climate change and organic farming; Various organic standards and organizations involved on it; Policies, provisions and practices for promoting organic agriculture in Nepal; Organic farming for production sustainability and food security; Recent advances in organic farming for food safety and community wellness.	

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Basics of Organic Farming	
1.1	Definition, history, concept, principles; Global scenario of organic farming	1
1.2	Chemical/pesticide pollution; Importance, scope and limitations of organic farming in maintaining the global and Nepalese food security	1
1.3	Conventional Vs Organic Farming; Basic components of organic farming	1
2	Land Use in Agriculture Production	
2.1	Land as source of production and asset; Scenario of land use in Nepal; Land use Act, Policies, Provisions and Practices of Land use in Nepal	1
2.2	Scope of organic agriculture and its relevance to Nepal; Perception regarding land in organic farming, suitable land for organic agriculture	1
3	Organic Approach to Soil Fertility Management	
3.1	Important aspects of soil management in organic farming; Role of organic matter in soil fertility and productivity; Integrated nutrient management (INM) and balance fertilization	1
3.2	Integrated Plant Nutrient Supply System (IPNS); Soil organic matter content; Organic sources of nutrients (Biofuel crops, crop rotation, inter-cropping, green manures, cover crops, crop residue management, bio-fertilizers, mulching, organic manures, waste recycling, Compost and FYM, Vermicompost, Organic fertilizers)	1
3.3	Indigenous technical knowledge (soil, nutrient, water management), problems and prospects in organic agriculture; Soil micro-organisms/ soil biology	1
4	Organic Approach to Weed, Disease and Pest Management	
4.1	Identification of field plants and learn about their uses; Identification of pests and beneficial organisms	1
4.2	History of chemical weed and pest management, present trend of agro-chemical use and health hazard to human and nature	1
4.3	Maintaining biodiversity for insect, disease, weed management; Non-chemical approach to weed management (prevention, cultural practices, competitive crops, cover crops, biological weed management, bio-herbicide	1

	use)	
4.4	Biological and indigenous methods for disease management; Organic method for insect-pests management	1
4.5	Global status of pesticide production and application; Trade and politics in agro-chemicals	1
5	Organic Crop Production	
5.1	Varietal improvement, seed selection and seed banking (seed requirements and standards for organic crop production in Nepal; Key organic seed producers in Nepal and abroad)	1
6	Organic Animal Production	
6.1	Principles and scope of Organic Animal Production in Nepal	1
6.2	Modern Vs Organic Animal Production	1
7	Various Models of Organic Farming	
7.1	Natural Farming, Permaculture, Ecological Farming and their differences and similarities, DEED model in managing organic resources in farmer's field	1
8	Climate Change and Organic Farming	
8.1	Dry land agriculture and its challenges; Dry land organic agriculture	1
8.2	Climate Smart Agriculture (CSA) and its scope in producing organics in Nepal	1
9	Policies, Provisions and Practices for promoting Organic Agriculture in Nepal	
9.1	Policies and provisions for promoting organic agriculture in Nepal	1
9.2	Agencies and Institutions related to organic agriculture in Nepal and abroad	1
9.3	National and International status of organic farming; Key organic products	1
10	Organic Products Quality and Standards	
10.1	National standards for organic products; Need and Criteria for organic product qualification	1
10.2	Organic certification and accreditation process	1
10.3	Processing, leveling, economic considerations and viability of organic produce	1
10.4	Organic products marketing and export potential	1
11	Organic farming for production sustainability and food security in Nepal	1
12	Recent advances in organic farming for food safety and community wellness	2
13	Organic production of representative agronomic crops (cereals, legumes, oilseeds, potato and other NUS)	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Preparation of vermi-compost at lab scale from various kinds of agro-waste	1
2	Preparation of Jholmal, Compost (rural/urban) and Botanical pesticide	1
3	Maintenance of bio-fertilizer strains, culture of bio-fertilizers and their applications	1
4	Organic Vs Inorganic cultivation and comparison of same crop	1

5	Comparison of the structure of soil in traditional and organic farming	1
6	Study of indigenous practices in organic fertilizer management	1
7	Identification of local plant resources and indigenous practices for insect pest management (standing crops and stored seeds) in your locality	1
8	Test the effectiveness of biological products in pest and disease control-summer season [student should bring their own idea (different student different test)]	1
9	Measure of soil health differences based on soil biota in chemically and organically managed soil	1
10	Study the nutritive value of foods produced in organically Vs chemically managed soil	1
11	Identification and listing of different institutions working in organic production and marketing in Nepal and their major roles and responsibilities	1
12	Study of policies and incentives related to organic agriculture in Nepal and in your Palika	1
13	Identification of beneficial and harmful plants, insects and micro-organisms in the field	1
14	Analysis of organic input and flow of a farm enterprise using DEED model	1
15	Visit to organic farm nearby the college	1
	Total	15

Recommended Reading Materials

1. Bhandari, D.R. (2063). *A Hand Book of Organic Agriculture*. Janaki Bhandar, Rupandehi.
2. Dahal, K. R., Sharma, K. P., Bhandari, D. R. and Regmi, B. D. (2015). *Organic Farming for Sustainable Agriculture*, Nandwani, Dilip (Ed.) Springer 137:168.
3. Eyhorn, F., Heeb, M. and Weidmann, G. (2002). *Training Manual for Organic Agriculture in the Tropic*. International federation of Organic Agricultural movement (IFOAM), Germany.
4. Jaisi, S. (2062). *An Introduction to Organic Farming (in Nepali)*. Treta Agro-concern Pvt. Ltd, Nawalparasi, Nepal.
5. Joshi, M and. Pravakarasethi, T. K. (2006). *Sustainability through Organic Farming*. Kalyani Publishers, India.
6. Mansata, B. (2008). *Organic Revolution! The Agricultural Transformation of Cuba since 1990*. Earthcare Books, Kolkata, India.
7. Mansata, B. (2010). *The vision of Natural Farming*. Earthcare Books, Kolkata, India.
8. Sharma, K.P. and K.R. Dahal. (2017). *Sustainable Agriculture Development in Nepal: Need for Paradigm Shift in Theory and Practice*. Chapter 4. IIDS at Kathmandu University (2017). Nepal Economic Outlook Special Edition: Selected Essays on Nepali Economy. Kathmandu.
9. Periodicals and News Letters published by IFOAM, BiFL, ILEA, Slow Food, Grain, etc.
10. Periodicals and News Letters published by NPG, USC Nepal, World Neighbor, World Vision, ICIMOD, HELVETAS and related I/NGOs in the country.

Course Code	AGR621
Course Title	Advanced Agronomy, Biodiversity Conservation and NUS
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course	
Upon completion of this course, students will gain knowledge about different concepts of farming system including precision farming, biodiversity conservation, status and importance of neglected and underutilized crop species. Students will be able to identify the major NUS (Neglected and Underutilized Crop Species) crops, constraints in their utilization, understand strategies and develop practical approaches for their promotion along with their agronomy and management practices.	
Course Description	
Introduction to Nepalese farming system; Rainfed farming; Farming system research and methodology; New approaches of farming: Contract farming, crop diversification, bio-fortification, precision farming, resource conservation technologies (RCTs); Biodiversity conservation; Crop simulation modeling; Traditional knowledge and information associated with neglected and underutilized species, its extent and distribution, richness, importance; Crop husbandry of NUS cereals and pseudo cereals, roots and tubers, legumes and vegetables and promoting conservation and use of NUS crop species for healthy food.	

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Nepalese Farming System and Farming System Research Methodology	
1.1	Introduction to Nepalese farming, their characteristics and major farming systems adopted in irrigated and rainfed farms in Nepal	1
1.2	Farming System Research, their evolution, characteristics and research methodology	1
2	Conventional and Modern Agriculture and Food Security Status in Nepal	
2.1	Scope, practices and economic importance of major food crops in developed and developing world and advances in agriculture and Nepalese food security concerns as defined by SDG goals	1
2.2	Environmental concerns related to intensive use of agricultural inputs and basics on GM crops and transgenic crops in the diversification at global level for improved food and nutritional security	1
3	Precision Farming, Crop Planning and Budgeting	
3.1	Current status and opportunities for adoption of precision agronomy in Nepal, various precision agriculture tools like GIS, GPS, RS, SPAD, NDVI, LCC, SSNM and NOPT, and fertilizer models (Nutrient Expert)	1

3.2	Crop planning and budgeting to increase productivity, profitability and diversification of agri-enterprises	1
4	Protected Agriculture, Contract Farming, and Crop Diversification	
4.1	Concept, characteristics and types of protected agriculture and contract farming, and their scope and limitations in Nepal	1
4.2	Concept, characteristics and types of crop diversification, and scope and limitations of crop diversification in Nepal	1
5	Conservation Agriculture and Resource Conservation Technologies (RCTs)	
5.1	Definition, principles and practices of conservation tillage and conservation agriculture and scope of crop residue management under sole and multiple cropping systems	1
5.2	Resource conservation technologies and modern approaches for improving resource-use efficiency (fertilizer, water, weed and energy) of major crops and cropping systems in Nepal	1
6	Climate Change Adaptation and Mitigation Measures, and Water-use Efficiency	
6.1	Climate change and variability, adaptation and mitigation measures in agronomic crops, agro-climatic indices and their importance in crop production	1
6.2	Water balance in the soil and crop production under nutrient and moisture limitations, ways to increase water use efficiency, stress crop production, crop production by moisture availability and potential evapo-transpiration	1
7	Crop Cut Survey, Yield Forecasting and Crop Simulation Modeling	
7.1	Yield estimation and forecasting tools in agriculture and modern approaches of crop yield forecasting	1
7.2	Crop cut survey and its implications, definition, uses, types, scope and limitation of crop simulation models	1
8	Concept of Biodiversity	
8.1	Definition of biodiversity; Types and importance of biodiversity; Objectives and methods of biodiversity conservation	1
8.2	Biodiversity conservation in Nepal; Works of different organizations working for biodiversity conservation in Nepal and world	1
9	NUS and its Importance	
9.1	Definition and importance of neglected and underutilized crop species (NUS), their distribution and role in food and nutrition security, healthy diet and food systems	1
9.2	Traditional food culture and knowledge systems associated with those crops, current status and future potentiality to promote as new foods	1
10	Introduction, importance and use (managing soil health and nutritional benefit) intercropping, value addition, seed and seed materials, conservation	

10.1	Cereals: Eincorn wheat (<i>Triticum monococcum</i>), Finger millet (<i>Eleusine corocana</i>), Kodo millet (<i>Paspalum scroticulatum</i>), Foxtail millet (<i>Setarica italicum</i>), Porso millet (<i>Panicum miliaceum</i>)	1
10.2	Pseudo-cereals: Amaranth (<i>Amaranthus</i> spp.) and Buckwheat (<i>Fagopyrum esculentum</i>), sorghum	1
10.3	Roots and Tubers: Yams (<i>Dioscorea</i> sp.), Taro (<i>Colocasia esculenta</i>), Parsnip (<i>Pastinaca sativa</i>) and Oca (<i>Oxalis tuberosa</i>)	1
10.4	Fruits and nuts: Monkey orange (<i>Strychnos cocculoides</i>), Key apple (<i>Dovyalis caffra</i>), Tree graped (<i>Lamnea</i> sp)	1
10.5	Fruits and nuts: Star fruit and Strawberry tree (<i>Arbutus unedo</i>) custard apple, jujube fruit, marmelus, rasp berry, Emblika	1
10.6	Legumes: Adzuki bean (<i>Vigna angularis</i>), Rice bean (<i>Vigna umbellata</i>), Lupin (<i>Lupinus mutabilis</i>), Lablab (<i>Lablab purpureus</i>) and Jack bean (<i>Canava liaensiformis</i>), Horse gram, Pigeon pea, Broad bean	1
10.7	Vegetables: Leaf amaranthus (<i>Amaranthus</i> sp.) Locust bean (<i>Parkia bigobosa</i>), Winged bean (<i>Psophocarpus tetragonolobus</i>)	1
10.8	Vegetables: Angle gourd (<i>Luffa aculiangula</i>), Chyote (<i>Sechuim edule</i>) and Jute (<i>Corchous oltorius</i>), Bitter gourd (<i>Momordica charantia</i>), tree tomato	1
11	Good practices for promoting conservation and sustainable use of NUS	1
12	Practical strategies and approaches to promote under-utilized and NUS crops (consumer awareness and linking with crop breeding, product development/diversification, healthy foods, food menu at hotels/ homestays etc.)	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Collection and identification of seeds of NUS	1
2	Preservation of NUS seeds	1
3	Cultivation, care and maintenance of seasonal NUS plant species	1
4	Field visit to study some of the wild species and their market potentialities	1
5	Identification of plant diseases based on NUS plants	1
6	Identification of insects attacking NUS plants	1
7	Study on soil type and climatic requirements of NUS plant	1
8	Collection of local knowledge about NUS plant and writing report	1
9	Learning visit to nearby communities and organization/ entrepreneurs promoting NUS based foods	1
10	Introduction to farming system research approaches and methodology	1
11	Study on farming system research and extension approaches in Nepal	1
12	Various PRA and RRA tools used in farming system research	1
13	Conceptualization of mother and baby/diamond trials in farming system research	1
14	Group study on various different PRA tools and its presentation by the students' group	1
15	Forcell analysis of seeds for knowing biodiversity in a village	1
	Total	15

Recommended Reading Materials

1. Van Heum, E. and Kees, Van der Post. (2004). *Protected Cultivation: Construction, requirements and use of greenhouse in various climates*. Agromisa Foundation, Wageningen, Netherlands.
2. FAO. (1998). *Farming Systems and Poverty: Improving farmers' livelihoods in a changing world*: www.fao.org/3/a-ac349e.pdf.
3. Govardhan, V. (2000). *Remote Sensing and Water Management in Command Areas: Agro ecological Prospectives*. IBDC.
4. Hunter, D., Borelli, T., and Beltrame, D.M.O. (2019). *The potential of neglected and underutilized species for improving diets and nutrition*. *Planta* 250, 709–729.
5. Jana, B.L. (2008). *Precision Farming*. Agrotech Publishing Academy, Udaipur.
6. Joshi B.K., Shrestha, R., Gautam, I.P., Poudel, A.P. and Gotame, T.P. (2019). *Neglected and Underutilized Species (NUS), and Future Smart Food (FSF) in Nepal*. National Agriculture Genetic Resources Center (NAGRC, National Genebank), NARC, Khumaltar, Kathmandu, Nepal.
7. Joshi, B.K., Shrestha, R., Gauchan, D., and Shrestha, A. (2020). *Neglected, underutilized, and future smart crop species in Nepal*. *Journal of Crop Improvement*, 34:3, 291-313.
8. NAAS. (2009). *State of Indian Agriculture*. National Academy of Agricultural Sciences, New Delhi.
9. Nanduri, K.R. and Mohammad Shahid. (2013). *Neglected and underutilized crops for sustainable agriculture in marginal areas*. Paper presented in 3rd International Conference on Neglected and Underutilized Species: for a Food-Secure Africa.

10. Negi, S.S. (2008). *Biodiversity and its Conservation in India*. Indus Publishing Company.
11. Padulosi, S., Thompson, J., and Rudebjer, P. (2013). *Fighting poverty, hunger and malnutrition with neglected and underutilized species (NUS): Needs, challenges and the way forward*. Biodiversity International, Rome.
12. Palaniappan, S.P. and K. Annadurai. (2006). *Organic Farming - Theory and Practice*. Scientific Publ.
13. Penning de Vries, F.W.T. and Van Laar, H. H. (Eds.). (1982). *Simulation of Plant Growth and Crop Production*. Wageningen Centre for Agricultural Publications and Documentation, Netherlands.
14. Sharma, P. (2007). *Contract Farming*. Daya Publishing House, New Delhi.
15. Will, M. (2008). *Promoting Value Chains of Neglected and Underutilized Species for Pro-Poor Growth and Biodiversity Conservation*. Guidelines and Good Practices. Global Facilitation Unit for Underutilized Species, Rome, Italy.

Genetics and Plant Breeding

Course Code	PLB221
Course Title	Fundamentals of Genetics
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
To acquaint the students with the theory and principles of genetics applied in plant breeding for higher agriculture productivity. By the end of the course, the students will be able to: <ol style="list-style-type: none"> i) Discuss and understand the basic concepts of cell, chromosomes and DNA ii) Identify various stages of cell division, both mitosis and meiosis iii) Apply genetic principles for plant breeding and crop improvement iv) Apply chi-square test for fitness of the data v) Explain different epistatic factors and generate linkage maps
Course Description
Cytology and cytogenetics, cell division; Mendelian genetics; Life cycle of maize, human, virus and bacteria; Sex determination; Linkage; DNA structure and function, chromosome and its abnormalities, mutation

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Definitions of cytology, genetics, cytogenetics, plant breeding, inter-relationships among them and with other branches of science	1
2	Genetics history-historical development, cell theory	1
3	Mitosis cell division	1
4	Meiosis cell division	1
5	Life cycles maize and human	1
6	Life cycles virus and bacteria	1

7	Introduction to Mendelian genetics, Mendel's laws of inheritance	1
8	Mendel's experiment and reasons for selecting pea as experimental material, characters studied, reasons for Mendel's success	1
9	Dihybrid ratio exceptions to Mendel's law, backcross and testcross	1
10	Gene action and interaction	1
11	Types of epistasis	1
12	Probability testing	1
13	Chi-square testing	1
14	Sex determination in plant and animal	1
15	Linkage, coupling and repulsion phase of linkage, types of linkage	1
16	Theories of linkage, linkage identification experiments, significance of linkage in plant breeding, differences between linkage and pleiotropism	1
17	Crossing over, factors affecting crossing over, mechanism of crossing over, significance of crossing over in plant breeding	1
18	Cytoplasmic inheritance, classes of cytoplasmic inheritance, characteristics influenced by cytoplasmic inheritance, differences between chromosomal and extrachromosomal inheritance	1
19	DNA structure and function, Watson and Crick model of DNA double helix, classification of DNA	1
20	Proof that DNA is the genetic material, transformation, transduction, bacteriophage infection and biochemical evidences	1
21	DNA replication, modes of DNA replication, semi conservative DNA replication, experimental proof of generalized model for DNA replication	1
22	DNA repair, restriction endonucleases, types of DNA repair systems, renaturation and denaturation of DNA	1
23	RNA structure and function, mRNA, rRNA, tRNA and genetic code and their properties	1
24	Central dogma of molecular biology, transcription, translation and protein synthesis	1
25	Regulation of gene expression, important terms related to gene regulation, regulation of gene expression in prokaryotes (Operon model by Jacob and Monod)	1
26	Transposable genetic elements	1
27	Characters of mutations, physical and chemical mutagens, detection of sex linked lethals in <i>Drosophila</i> (CIB method given by Muller)	1
28	Importance of mutation in plant breeding programs, xenia and metaxenia, molecular basis of mutations	1
29	Structural and numerical chromosomal aberrations and types	1
30	Breakage - fusion - bridge cycle in chromosomal aberrations, deletions (deficiency), duplications and significance of chromosomal changes	1
	Total	30

Course Breakdown (Practical)

SN	Course Outline	Lectures
1	Microscopy	1

2	Mitosis	1
3	Meiosis	1
4	Monohybrid ratio and its modification	1
5	Dihybrid ratios and its modification	1
6	Numerical problem related to Mendel's law of segregation	1
7	Independent assortment	1
8	Numerical problem related to gene actions and interactions	1
9	Epistasis	1
10	Chi-square analysis	1
11	Numerical problem related to Linkage	1
12	Numerical problem related to crossover	1
13	Numeral problem related to sex determination	1
14	Field demonstration of male sterility	1
15	Self-incompatibility in crop plants	1
	Total	15

Recommended Reading Materials

1. Gardner, E. J. (1972). *Principles of Genetics* (No. 4). London, UK, John Wiley and Sons, Inc.
2. Pierce, B. A. (2012). *Genetics: A Conceptual Approach*. Macmillan.
3. Russel, P. J. (2010). *Genetics: A Molecular Approach*, 3rd Edition, Pearson Publication.
4. Snustad, D. P. and Simmons, M. J. (2015). *Principles of Genetics*. John Wiley and Sons.
5. Stickberger, M. W. (2012). *Genetics (3rd Ed.)*. PHI Learning Private Limited, New Delhi India.
6. Welsh, J. R. (1981). *Fundamentals of Plant Genetics and Breeding*. John Wiley and Sons.

Course Code	PLB421
Course Title	Fundamentals of Plant Breeding
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
<p>This course is focused on the basic concept of plant breeding, its relationships with other disciplines, and application of the genetic principles for crop improvement. By the end of the course, the students will be able to:</p> <p>i) Discuss and understand the basic concepts of plant breeding and its role in crop improvement</p> <p>ii) Know about plant germplasm source, introductions, modes of reproduction and crossing methods in self- and cross-pollinated crops</p> <p>iii) Know about the hybridization techniques, heterosis and breeding methods in self- and cross-pollinated crops</p> <p>iv) Apply the breeding principles during maintenance breeding and seed certification</p> <p>v) Understand the principles of developing new varieties, release and intellectual property right</p>
Course Description

Scope and history of plant breeding; Plant introduction and domestication; Modes of reproduction; Inheritance of qualitative and quantitative characters or traits; Biometrical techniques in plant breeding; Selection and hybridization in crops; Heterosis, mutation breeding, polyploidy; Release of new cultivars; Crop improvement in Nepal and plant breeding institutions.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction to plant breeding, history, objectives, activities	1
2	Achievements, constraints, opportunities, characteristics improved by plant breeders	1
3	Pattern of evolution in crop plants, center of origin of bio-diversity, germplasm and its conservation, plant introduction and acclimatization, significance of germplasm sources in plant breeding	1
4	Modes of reproduction and pollination control methods, anthesis pollination, inbreeders and outbreeders	1
5	Mechanisms promoting self-pollination and cross pollination in crop plants and their significance in plant breeding	1
6	Qualitative and quantitative inheritance of characters or traits, experiments on qualitative and quantitative inheritance of traits in plants	1
7	Population genetics and Hardy Weinberg principle	1
8	Biometrical techniques and their applications in plant breeding (assessment of variability, aids to selection)	1
9	Choice of parents, crossing techniques, genotype by environment interactions	1
10	Breeding methods in self-pollinated crops: pure line theory, pure line selection, mass selection methods, line breeding	1
11	Pedigree selection, bulk selection, backcross method, single seed descent method, multiline method, di-allele selective mating and population breeding	1
12	Breeding methods in cross pollinated crops: selection, response to selection, mass selection, progeny testing, ear to row method	1
13	Progeny selection, recurrent selection schemes for intra and inter-population improvement, development of synthetic and composite varieties and population breeding	1
14	Hybrid breeding, genetical and physiological basis of heterosis and inbreeding	1
15	Production of inbred lines, breeding approaches for improvements of inbred lines, prediction of hybrid performance	1
16	Seed production of hybrid and their parent varieties/inbred lines.	1
17	Breeding methods in asexually/clonally propagated crops	1
18	Clonal selection and apomixis breeding	1
19	Self-incompatibility and male sterility in crop plants and their significance in plant breeding	1
20	Concept of plant ideotype and its role in crop improvement	1
21	Mutation breeding, breeding for abiotic stress	1
22	Breeding for pest resistance	1

23	Breeding for disease resistance	1
24	Cultivar development-testing, release and notification	1
25	Maintenance breeding, participatory plant breeding	1
26	Quality seed, production and maintenance	1
27	Crop improvement in Nepal (Wheat and Rice)	1
28	Crop improvement in Nepal (Maize and Legumes)	1
29	Crop improvement in Nepal (Oilseeds, Millets, Vegetables, Fruits, Spices, etc.)	1
30	Intellectual property rights in plant breeding and international agreements regarding plant varietal protection	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study the plant breeder's kit	1
2	Germplasm collection and conservation	1
3	Study of floral parts of field crops	1
4	Hybridization techniques in self-pollinated crops	2
5	Hybridization techniques in cross-pollinated crops	2
6	Plant breeding data recording and trial evaluation	1
7	Determining genetic purity of seed in the lab	1
8	Methods of maintaining genetic purity in the field	1
9	Scoring field data and determining resistance/susceptibility to disease and pest	1
10	Describing the traits for release of a new variety	1
11	Study plant breeding trials on research station and on farm trials	1
12	Analysis of variance (ANOVA) and its use in plant breeding	1
13	Estimation of heritability and genetic advance	1
	Total	15

Recommended Reading Materials

1. Acquaah, G. (2009). *Principles of Plant Genetics and Breeding*. John Wiley and Sons.
2. Chopra, V. L. (Ed.). (1989). *Plant Breeding: Theory and Practice*. South Asia Books.
3. Gupta, S. K. (Ed.). (2000). *Plant Breeding: Theory and Techniques*. Agrobios.
4. Poehlman, J. M. and Sleper, D. A. (1995). *Breeding Field Crops*. 4th Iowa State University Press. Ames, USA P, 494.
5. Singh, B. D. and Singh, B. D. (1999). *Textbook of Plant Breeding*. Kalyani publishers.

Course Code	PLB521
Course Title	Molecular Approaches in Plant Breeding
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Students pursuing this course will acquire theoretical knowledge and practical skills on plant biotechnology, different molecular tools and approaches used in plant breeding for crop improvement.
Course Description
Nature of gene; Application of biotechnology in plant breeding, Restriction enzymes, vectors, electrophoresis, PCR, Blotting techniques, rDNA technology; Transformation methods, transgenes, markers, tissue culture, marker assisted selection; QTLs, mapping population, GMO issues; Biosafety measures and intellectual property rights in plant breeding.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Historical background of molecular genetics, genetic material in organisms	1
2	Central dogma of molecular biology and its applications in plant breeding	1
3	Classical and modern concept of gene, fine structure of gene, gene theories	1
4	Gene expression and regulation of gene expression in eukaryotes (Britten and Davidson model), genetic code properties	1
5	Biotechnology definitions and history, biotechnology in Nepal	1
6	Plant biotechnology, applications, achievements, future aspects and relationship with other sciences	1
7	Nucleic acid isolation and storage	1
8	Polymerase chain reaction, gel electrophoresis and SDS page	1
9	Reverse transcription and cDNA synthesis	1
10	Quantitative and qualitative estimation of DNA, RNA and protein in an organism	1
11	Blotting techniques for DNA and RNA	1
12	Gene cloning, restriction enzymes and their types	1
13	Gene cloning vectors and their types: Plasmid, Phage, Phasemid, Cosmids, BACs, YACs	1
14	Recombinant DNA technology and methods of gene transfer	1

15	<i>Agrobacterium</i> mediated gene transfer, traitor genes and terminator genes	1
16	Morphological, biochemical and genetic markers in plant breeding	1
17	Molecular markers and its types (PCR and non-PCR based markers)	1
18	Marker assisted selection for qualitative and quantitative traits, gene pyramiding	1
19	Statistical tools in marker analysis, application of molecular markers in crop improvement	1
20	Marker-assisted backcross breeding for rapid introgression of traits	1
21	Mapping populations (F2s, back crosses, NILs, RILs and double haploids)	1
22	Quantitative trait loci (QTL), genome wide association mapping	1
23	Introduction to omics approaches (genomics, proteomics, metabolomics, ionomics etc.) in molecular plant breeding	1
24	Bio-informatic tools and its use for molecular plant breeding	1
25	Biotechnology applications in hybrid breeding	1
26	Transgenes, transgenic approaches in crop improvement	1
27	Plant cell and tissue culture, principle and types (callus, cell suspension, anther culture, ovule culture, meristem culture and embryo culture)	1
28	Haploid and triploid production, somatic hybridization, cybridization	1
29	Somaclonal and gametoclonal variation, wide hybridization <i>in vitro</i>	1
30	GMOs and related issues (risk and regulations); International regulations and biosafety issues, intellectual property right	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Laboratory handling and safety measures	1
2	Organization of tissue culture laboratory	1
3	Identification of tools of tissue culture laboratory	1
4	Elementary chemical calculations	1
5	Preparation of buffers and reagents	1
6	Tissue culture media preparation	1
7	Tissue culture propagation	1
8	Plant genomic DNA isolation	1
9	Quantification of DNA and agarose gel electrophoresis	1
10	Demonstration of PCR	1
11	RNA isolation	1
12	Sterilization techniques used in plant tissue culture	1
13	Somaclonal variations in tissue culture	1
14	Hardening and field evaluation of tissue culture products	1
15	Accessing and storing genetic databases	1
	Total	15

Recommended Reading Materials

1. Abdin, M. Z., Kiran, U. and Ali, A. (Eds.). (2017). *Plant Biotechnology: Principles and Applications*. Springer Singapore.
2. Chopra, V. L. and Nasim, A. (1990). *Genetic Engineering and Biotechnology; Concepts, Methods and Applications* (No. 660.65 G328). Oxford and IBH Publishing.
3. Howe, C. (2007). *Gene cloning and manipulation*. Cambridge University Press.
4. Sambrook J. and Russel D. (2001). *Molecular Cloning - a Laboratory Manual*. 3rd Edition. Cold Spring Harbor Laboratory Press.
5. Singh, B. D. and Singh, B. D. (2007). *Biotechnology Expanding Horizons*. Kalyani Publishers.
6. Xu, Y. (2010). *Molecular Plant Breeding*. CABI.

Course Code	PLB721
Course Title	Field Crop Improvement
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course	
This course provides insight on plant breeding approaches for crop improvement, develop understanding on plant genetic resources and innovative approaches in plant breeding for field crop improvement.	
Course Description	
Plant breeding history and achievements, inter-relationship; Plant genetic resources; Breeding for biotic and abiotic stress tolerance; Breeding for quality improvement; Breeding objectives and approaches used in different crops; Crop ideotypes; Participatory and evolutionary plant breeding; Gnotype-environment interaction; Varietal registration, release and notification, seed production and inspection; Plant breeding organizations, rules and regulations.	

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	History of plant breeding in Nepal, plant breeding phases and their activities	1
2	Conventional and modern approaches of plant breeding, principles of plant breeding, relationship with other sciences	1
3	Definition of plant genetic resources, gene pool, kinds of germplasm sources and significance	1
4	Germplasm collection, conservation, utilization, introductions and acclimatization	1
5	Biotic and abiotic stress in crop plants and their impacts	1
6	Breeding for disease resistance, mechanisms and types of disease resistance, gene for gene hypothesis, disease scoring, practical achievements	1
7	Breeding for insect resistance, mechanisms of insect resistance, insect pest	1

	damage scoring, practical achievements	
8	Breeding for abiotic stress tolerance, types of abiotic stress	1
9	Drought tolerance: Introduction, mechanism of drought tolerance, breeding methods, achievements	1
10	Salinity tolerance: Introduction, mechanism of salinity stress tolerance, breeding methods, achievements	1
11	Heat stress tolerance: Introduction, mechanisms, breeding methods, achievements	1
12	Breeding for quality improvement: Introduction, quality traits, nutrition & nutrients, nutritional quality of cereals, fruits and vegetables, sources of nutritional quality, breeding methods, trait associated gene identification, achievements	1
13	Center of origin, law of parallel series, exploitation of heterosis through hybridization, earlier experiments on crop hybridization in cereals, fruits and vegetable crops, types of hybridization and matings	2
14	Apomixis and heterosis breeding, significance in crop improvement	1
15	Chromosomal variations and inheritance in wheat, rice, maize, tomato, soyabean, bean and rapeseed	1
16	Crop improvement activities and breeding methods in Rice	1
17	Crop improvement activities and breeding methods in Wheat and Barley	1
18	Crop improvement activities and breeding methods in Maize	1
19	Crop improvement activities and breeding methods in Pulses (chickpea, soybean, blackgram, mungbean etc.)	1
20	Crop improvement activities and breeding methods in oilseed (rapeseed, mustard, linseed, sunflower, sesame etc)	1
21	Crop improvement activities and breeding methods in vegetable (tomato, potato, onion, brinjal and brassica species etc)	1
22	Crop improvement activities and breeding methods in spice and medicinal crops (turmeric, ginger, garlic, coriander, black pepper, cardamom etc)	1
23	Ideotype concept in crop improvement, objectives and challenges	1
24	Characteristics of crop ideotype (cereal, legumes, oilseeds, spices, fruits and vegetable crops)	1
25	Genotype by environment interaction and multi environment trials in plant breeding, on station and on farm trials, varietal registration, release and notification, classes of seeds	1
26	Role of participatory plant breeding in varietal development and adoption by farmers	1
27	Role of evolutionary plant breeding in climate resilient variety development, climate resilient crops and their use	1
28	National and International plant breeding organizations	1
29	National and International rules and regulations regarding plant variety protection and benefit sharing, plant breeder's right and farmer's right, germplasm conservation and utilization through national and international gene banks	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Conventional and molecular tools used in plant breeding	1
2	Layout and establishment of field experiment	c
3	Field trial data recording	1
4	Handling segregating materials	1
5	Collection of germplasm of field crops and preservation	1
6	Study and collection of landraces and their important traits	1
7	Study and collection of popular released varieties and their important traits	1
8	Hybridization in self-pollinated crops	1
9	Hybridization in cross-pollinated crops	1
10	Estimation of genetic gain	1
11	Estimation of heritability and heterosis	1
12	Hybrid seed production using A, B and R system	1
13	Seed production and maintenance in self-pollinated crops	1
14	Seed production and maintenance in cross-pollinated crops	1
15	Visit to seed production plot and field inspection	1
	Total	15

Recommended Reading Materials

1. Abdin, M. Z., Kiran, U. and Ali, A. (Eds.). (2017). *Plant Biotechnology: Principles and Applications*. Springer Singapore.
2. Brown, J. (2008). *An introduction to Plant Breeding*, Jack Brown, Peter DS Caligari.
3. Joshi, B. K. (2017). *Plant Breeding in Nepal: Past, present and future*. Journal of Agriculture and Forestry University, 1, 1-33.
4. Ram, M. (2014). *Plant Breeding Methods*. PHI Learning Pvt. Ltd.
5. Singh, B. D. (2015). *Plant Breeding: Principles and Methods*. Kalyani publishers.
6. Sleper, D. A. and Poehlman, J. M. (2006). *Breeding Field Crops* (No. Ed. 5). Blackwell publishing.

Animal Science and Aquaculture

Animal Science

Course Code	ASC121
Course Title	Fundamentals of Animal Science
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of the course, the students will be able to understand the domestication of farm animals and avian species and will also be able to know general husbandry practices of farm animals and avian species.
Course Description
Introduction, importance, scope and problems and statistics of livestock and their products in Nepal; Vocabulary of livestock production and common terms of managerial practices in livestock and poultry farming; Zoological classification of ruminants, non-ruminants and poultry; Breed characteristic of indigenous and exotic breeds of cattle, buffalo, sheep, goat, pig and poultry recognized in Nepal; Housings requirements- types, floor space, feeder and waterer and construction materials for farm animals; Care and management of different categories of ruminants and non-ruminants; Identification, ageing, body weight estimation of farm animals; Handling and restraining of farm animals; Marketing and transportation of farm animals and poultry birds; Feed classification and common feedstuffs and their nutrient content in Nepal; Use of NPN compounds, feed supplements and feed additives; Signs of health and disease and factors affecting health of farm animals; Care and management of sick farm animals and birds; Climate change and its impact on livestock farming, methods of mitigation; Summer and winter stress in farm animals and its amelioration practices; Waste disposal/utilization, sanitation and biosecurity; Different types of farm records and its importance.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction, importance, scope and problems and statistics of livestock and their products in Nepal	1
2	Vocabulary of livestock production and common terms of managerial practices in livestock and poultry farming	1
3	Zoological classification of ruminants, non-ruminants and poultry	1
4	Different between ruminant and non-ruminant animals	1
5	Breed characteristic of indigenous and exotic breeds of cattle common in Nepal - Khaila, Achami, Lulu, Yak, Chauri, Red Sindhi, Sahiwal, Hariyana, Holstein Friesian, Jersey, Brown Swiss	1
6	Breed characteristic of indigenous and Indian breeds of buffaloes common in Nepal- Lime, Parkote, Gaddi, Murrah, Nili-Ravi, Jaffrabadi, Surti, Meshana	1

7	Breed characteristic of indigenous and exotic breeds of goat common in Nepal- Tarai, Khari, Sinhal, Chyangra, Jamunapari, Barbari, Black Bengal, Beetal, Boer, Sannen	1
8	Breed characteristic of indigenous and exotic breeds of sheep common in Nepal- Lampuchhre, Kage, Barawal, Bhyanglung, Merino, Rambouillet, Polworth	1
9	Breed characteristic of indigenous and exotic breeds of poultry recognized in Nepal- Sakini, Ghatikhuile, Pwakhulte, Brahma, New Hampshire, Rod Island Red, Plymouth Rock, Leghorn, Austrolop	1
10	Breed characteristic of indigenous and exotic breeds of poultry common in Nepal- Giriraj; Broilers breeds: Cobb 500, Rose, Hubbard, Indian River; Layer Breeds: Hyline, Lohman, H and N Nick Brown	1
11	Breed characteristic of indigenous and exotic breeds of pigs common in Nepal- Chwache, Bampudke, Hurrah, Pakhribas Black, Hampshire, Landrace, Yorkshire, Duroc, Tamworth	1
12	Housings requirements- types, floor space, feeder and waterer and construction materials for cattle, buffalo, sheep and goat	1
13	Housings requirements- types, floor space, feeder and waterer and construction materials for pig and poultry	1
14	Care and management of ruminant animals- Calf/kid, heifer/grower, dry/suckling animals	1
15	Care and management of ruminant animals- pregnant, milking, breeding male and draft animals	1
16	Care and management of non-ruminants- Piglets, gilt, sows and breeding boar	1
17	Care and management of non-ruminants- Chick, pullet, layers, broiler	1
18	Identification and ageing of farm animals	1
19	Body weight estimation, castration, dehorning/disbudding of farm animals	1
20	Handling and restraining of farm animals	1
21	Marketing and transportation of farm animals and poultry birds	1
22	Feed classification and common feedstuffs and their nutrient content in Nepal	1
23	Use of NPN compounds, feed supplements and feed additives	1
24	Signs of health and disease and factors affecting health of farm animals	2
25	Care and management of sick farm animals and birds	1
26	Climate change and its impact on livestock farming and methods of mitigation	1
27	Summer and winter stress in farm animals and its amelioration practices	1
28	Waste disposal/ utilization, sanitation and biosecurity	1
29	Different types of farm records and its importance	1
30	A cursory review on the micro-syllabus of Fundamentals of Animal Science	1
	Total	30

Course Breakdown (Practical)

SN	Course Outline	Lectures
1	Visit to a cattle/buffalo, sheep/goat farm and observe the housing systems, breeds and records in a commercial farm	1
2	Visit to a poultry shed and piggery and observe the housing systems, breeds and records in a commercial farm	1
3	Identification of external body parts of ruminant animals	1
4	Identification of external body parts of non-ruminant and poultry birds	1
5	Identification of different equipment used in animal science laboratory	1
6	Study of body temperature, respiration rate and pulse rate of different animals	1
7	Casting and restraining of farm animals	1
8	Estimation of body weight by body measurement of cattle and buffalo	1
9	Estimation of body weight by body measurement of sheep, goat and pig	1
10	Age determination by dental formula in ruminant animals	1
11	Different methods of animal identification/numbering	1
12	Cleaning and disinfection of the barn/shed	1
13	Identification of feed ingredients and fodder	1
14	Grooming of dairy cow and practice on hand milking	1
15	Study different types of farm records and their uses	1
	Total	15

Recommended Reading Materials

- Banerjee, G.C. (1995). *Poultry (3rd Edition)*. Oxford and IBH Publishing. New Delhi.
- Banerjee, G.C. (2015). *A Text Book of Animal Husbandry (8th Edition)*. Oxford and IBH Publishing. New Delhi.
- Banerjee, G.C. (2018). *Principles of Animal Nutrition and Feeds*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
- Damron, W. S. (2012). *Introduction to Animal Science: Global, Biological, Social and Industry Prospective, (4th edition)*. PHI Learning Pvt. Ltd., M97 Connaught circus, New Delhi 110001, India.
- Dhital, B and Adhikari, M. (2016). *Principle and Practice of Livestock Production and Management*. Buddha Publication Pvt. Ltd. Kathmandu Nepal.
- ICAR. (2016). *Handbook of Animal Husbandry*. Indian Council of Agriculture Research, New Delhi India.
- John, R., Campbell, C., Kenealy, M., Dauglas, C. and Karen, L. (2013). *Animal Science (4th Edition)*. Scientific International Pvt. Ltd. New Delhi India.
- Prasad, J. (2016). *Animal Husbandry and Dairy Science (6th Edition)*. Kalyani Publishers, New Delhi India.
- Ranjkhani, S.K. (1993). *Animal Nutrition in the Tropics*. Vikash Publishing House Pvt. Ltd. India.
- Sastry, N.R.S. and Thomas, C.K. (2018). *Livestock Production and Management (5th Edition)*. Kalyani Publication, New Delhi India.
- Thomas, G.F. and R. E. Traylor. (2014). *Scientific farm animal production; An introduction to Animal Science, 10th edition*. PHI Learning Pvt. Ltd., Rimjhim house, 111 Patparganj, Industrial Estate, Delhi 110092, India.

Course Code	ASC211
Course Title	Ruminant Production
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to identify different breeds of farm animals and have knowledge on management practices.
Course Description
Breeds of cattle, buffalo, sheep and goat; Care and management of cattle, buffalo, sheep and goat; Housing principles and types of housing for ruminants; Artificial rearing of newborn calves, kids, lambs; Feeds and feeding of ruminants; Castration, dehorning/ disbudding, grooming, dipping, dusting, shearing of wool; Judging and selecting of farm animals; Use of draft animals, Milking methods and practices.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction, current statistics, scope and importance of ruminants animals and Zoological classification of ruminants	1
2	Breed characteristics of indigenous breeds of cattle: Khaila, Achami, Lulu, Yak, Nak and Chauri	1
3	Breed characteristics of exotic and Indian breeds of cattle: Jersey, Holstein Frisian, Brown Swiss, Hariyana, Sahiwal and Red Sindhi	1
4	Breed characteristics of buffalo: Lime, Parkote, Gaddi, Murrah, Surti, Jaffarabadi and Nili-Rabi	1
5	Breed characteristics of indigenous goats: Terai, Khari/hill goats, Chyangra and Sinhal	1
6	Breed characteristics of exotic goats: Barbari, Sannen, Jamunapari, Boer and Beetal	1
7	Breed characteristics of sheep - Kage, Bhyanglung, Baruwat, Lampuchhre, Merino, Rambouillet, Romney and Polworth	1
8	Housing system of cattle/buffalo- site selection, provision of housing, types of housing system with its merits and demerits	1
9	Housing system of sheep and goat- site selection, provision of housing and types of housing	1
10	Care and management of pregnant, lactating and new born cattle, buffalo, sheep and goat	1
11	Care and management of heifer, dry animals, and draft cattle and buffalo	1
12	Importance and methods of castration, dehorning, grooming, dipping and dusting of farm animals.	1

13	Improving ruminants through judging and selection	1
14	Sharing, grading for quality assessment, handling and marketing of wool.	1
15	Common milking method and practice	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of common breeds of Cattle and Buffalo	1
2	Identification of common breeds of sheep and goat	1
3	Housing types and model study of cattle and buffalo with practical references	1
4	Housing types and model study of sheep and goat with practical references	1
5	Identification of Ruminant: Tagging, Branding, Tattooing	1
6	Castration of large ruminants	1
7	Castration of small ruminants	1
8	Dehorning and debudding/disbudding in calves	1
9	Grooming of cattle and buffalo	1
10	Dipping and drenching in sheep and goats	1
11	Study of barn sanitation and maintenance of bio-security at farm level	1
12	Study of milking practices	1
13	Study of wool shearing methods in sheep	1
14	Judging and selection of cattle and buffalo	1
15	Economics of cattle, buffalo, sheep and goat farming (Case study)	1
	Total	15

Recommended Reading Materials

1. Banerjee, C.K. and N.N. Pathak. (2004). *Textbook on Buffalo Production*. Vikas Publishing House Pvt. Ltd. New Delhi.
2. Banerjee, G.C. (2015). *A Text Book of Animal Husbandry (8th Edition)*. Oxford and IBH Publishing. New Delhi.
3. Banerjee, G.C. (2018). *Principles of Animal Nutrition and Feeds*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
4. Dhital, B and Adhikari, M. (2016). *Principle and Practice of Livestock Production and Management*. Buddha Publication Pvt. Ltd. Kathmandu Nepal.
5. ICAR. (2016). *Handbook of Animal Husbandry*. Indian Council of Agriculture Research, New Delhi India.
6. John, R., Campbell, C., Kenealy, M., Dauglas, C. and Karen, L. (2013). *Animal Science (4th Edition)*. Scientific International Pvt. Ltd. New Delhi India.
7. Prasad, J. (2011). *Goat, Sheep and Pig Production and Management*. Kalyani Publishers, New Delhi India.
8. Prasad, J. (2016). *Animal Husbandry and Dairy Science (6th Edition)*. Kalyani Publishers, New Delhi India.
9. Sastry, N.R.S. and Thomas, C.K. (2018). *Livestock Production and Management (5th Edition)*. Kalyani Publication, New Delhi India.

Course Code	ASC311
Course Title	Non-Ruminant Production
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to identify different breeds, feed, and manage the non- ruminant livestock species.
Course Description
Prominent breeds of pig, care and management and feeding of different age groups of swine; Housing systems, materials used and spacing required, commonly used management practices; Prominent indigenous and commercial breeds of broilers and layers; Rearing and feeding of broilers and layers at different stages of growth; Housing systems, requirements and materials required and design of houses; Egg formation, selection of eggs for incubation; Factors essential for hatching; Brooding methods; Common managerial practices; Vaccination, debeaking, candling, sexing, selection and grading of eggs; Selection and culling of layers; Bio- security in a commercial farm.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction, current statistics, scope and importance of rearing non-ruminants and poultry; Zoological classification of non-ruminants and poultry	1
2	Common breeds of poultry: Rhode Island Red, New Hampshire, Australorp, Sussex, Leghorn, Sakini, Pwankhulte and Ghatikhuile	1
3	Common lines of commercial poultry: Commercial broiler: Cobb-500, Hubbard, Rose, Indian River; Layer: Hyline, Lohnman, H and N nick, Tetra and Giriraj	1
4	Common indigenous breeds of pig: Chwache, Bampudke, Hurra, Pakhribas Black	1
5	Common exotic breeds of pig: Landrace, Duroc, Tamworth, Hampshire, Bampudke and Yorkshire	1
6	Care and management of Horse, Mule and Donkey	1
7	Common care and management of pig (pregnant, lactating, breeding boar and piglet)	1
8	Common care and management of commercial poultry (Layer and Broiler)	1
9	Handling and restraining of Pig, Poultry, Horse, Mule and Donkey	1

10	Housing: Site Selection, types of housing, design of pig housing and barn sanitation	1
11	Housing: Site Selection, types of housing, design of poultry housing and barn sanitation	1
12	Brooding methods of poultry	1
13	Egg formation , selection of eggs for table purpose and incubation	1
14	Selection of egg for incubation and hatching process	1
15	Factors essential for successful hatching/ principle of incubation	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study of commonly used equipment in pig and poultry laboratory	1
2	Identification of external body parts of pig and poultry	1
3	Identification of exotic and indigenous breeds of pig	1
4	Identification of common indigenous breeds of poultry	1
5	Identification of common layer and broiler breeds of poultry	1
6	Housing types and model study of pig and poultry with practical references	1
7	Restraining and handling pig and poultry birds	1
8	Debeaking and vaccination of poultry	2
9	Methods of identification of pig (Tagging and Ear notching)	1
10	Castration of pig	1
11	Iron administration to piglets	1
12	Feeding practices of swine	1
13	Feeding practices of poultry	1
14	Study of different types of farm records: Pig and Poultry	1
15	Economics of pig and poultry raising (Case study of pig and poultry farmers)	1
	Total	15

Recommended Reading Materials

1. Banerjee, G.C. (1995). *Poultry (3rd Edition)*. Oxford and IBH Publishing, New Delhi.
2. Banerjee, G.C. (2015). *A Text Book of Animal Husbandry (8th Edition)*. Oxford and IBH Publishing, New Delhi.
3. Banerjee, G.C. (2018). *Principles of Animal Nutrition and Feeds*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
4. Das, S.K. (2016). *Poultry Production*. CBS Publishers and Distributors Pvt. Ltd. New Delhi India
5. John, R., Campbell, C., Kenealy, M., Dauglas, C. and Karen, L. (2013). *Animal Science (4th Edition)*. Scientific International Pvt. Ltd. New Delhi India.
6. Prasad, J. (2011). *Goat, Sheep and Pig Production and Management*. Kalyani Publishers, New Delhi India.

7. Sastry, N.R.S. and Thomas, C.K. (2018). *Livestock Production and Management (5th Edition)*. Kalyani Publication, New Delhi India.

Course Code	ASC510
Course Title	Animal Health Management
Credit Hours	1 (1+0)
Full Marks	25
Theory (Marks)	25
Practical (Marks)	00

Objective (s) of the Course

Upon completion of this course, the student will be able to know the common bacterial, fungal, viral and parasitic diseases prevalent in livestock, poultry and pet animals and their management.

Course Description

Terminologies related to animal health and disease; Clinical signs and symptoms of healthy and diseased animals; Approaching Animal: History taking, physical examination; Classification of animal diseases; Transmission of disease of domestic animals; Common bacterial diseases of livestock - HS, BQ, Anthrax, Mastitis, Brucellosis; Common viral diseases of livestock - FMD, PPR; Swine fever; Common bacterial and viral diseases of poultry- Newcastle disease, IBD, Marek's disease, Collibacillosis; Common parasitic diseases of livestock and poultry- Babesiosis, Theileriosis, Trypanosomiasis, Coccidiosis, Liver fluke, Ascariasis, Tapeworm; Metabolic diseases of livestock and poultry: Milk fever, Gout; Reproductive problems in livestock: Anestrous, Dystocia; Vaccination schedule for Cattle, Buffalo, Sheep, Goat, Pig and Poultry.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Common terminologies related to animal health and diseases	1
2	Clinical signs and symptoms of healthy and diseased animals	1
3	Approaching Animal: History taking, physical examination	1
4	Classification of animal diseases	1
5	Transmission of disease of domestic animals	1
6	Common bacterial diseases of livestock - HS, BQ, Anthrax, Mastitis, Brucellosis	1
7	Common viral diseases of livestock - FMD, PPR, Swine fever	1
8	Common bacterial and viral diseases of poultry- Newcastle disease, IBD, Marek's disease, Collibacillosis	2
9	Common parasitic diseases of livestock and poultry- Babesiosis, Theileriosis, Trypanosomiasis, Coccidiosis, Liver fluke, Ascariasis, Tapeworm	2
10	Metabolic diseases of livestock and poultry: Milk fever, Gout	1
11	Reproductive problems in livestock: Anestrous, Dystocia	1
12	Zoonotic diseases: Rabies-concept and examples	1
13	Vaccination schedule for Cattle, Buffalo, Sheep, Goat, Pig and Poultry	1
14	Total	15

Recommended Reading Materials

1. Aiello, S.E. (Ed). (2010). *Merc Veterinary Manual (10th Edition)*. 2010, Merc and Co. Inc. White House station USA.
2. Blood, D.C. and Rodostitis, G.M. (1989). *Veterinary Medicine, A Text book of the Disease of Cattle, Sheep, Pig, Goat and Horse (7th Edition)*. ELBS Publication
3. Chakravarti, A. (2011). *Text Book of Clinical Veterinary Medicine*. Kalyani Publishers, India
4. Chakravarti, A. (2011). *Text Book of Preventive Veterinary Medicine*. Kalyani Publishers, India
5. ICAR. (2016). *Handbook of Animal Husbandry*. Indian Council of Agriculture Research, New Delhi India.
6. Prasad, J. (2016). *Animal Husbandry and Dairy Science (6th Edition)*. Kalyani Publishers, New Delhi India.

Course Code	ASC521
Course Title	Animal Nutrition and Fodder Production
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to know nutrient requirements, common feed and fodder materials and feeding practices of farm animals.

Course Description

Terminology of animal nutrition; Comparative composition of plants and animal's cells and tissues; Classification, functions and deficiency symptoms of carbohydrates, protein, lipids, minerals and vitamins; Digestion, absorption and metabolism of nutrients in ruminants and non-ruminants; Importance of proximate analysis, feed formulation, feeding standards and nutrient requirements for different farm animals and poultry; Evaluation of nutrient value of feed; Storage, processing and mixing of diet and feed ingredients; Feeding management and nutrient requirement of ruminant and non-ruminant; Terminology of fodder and pasture production in Nepal; Factor affecting nutritive value of fodder and classification of forage and anti-nutritional factors present in forage; Cultivation practices of important legumes and non-legumes including grasses; Alternative feeding resources in use and practice; Hay and silage making and their importance; Silvi-pastoral system and its importance.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Terminology related to animal nutrition	1
2	Comparative composition of plant and animal cells and tissues	1
3	Classification, function, requirement and food sources of carbohydrate, protein, lipid (fat), macro- and micro- minerals, vitamins and water	2
4	Digestion, absorption and metabolism of food and nutrients in ruminant animals	2

5	Digestion and absorption and metabolism of food and nutrients in non-ruminant animals	2
6	Feed formulation and feeding standard for ruminant (cattle, buffalo, sheep and goat)	2
7	Feed formulation and feeding standard for non-ruminants and poultry (pig and poultry)	2
8	Evaluation of nutrient value of feed; digestibility coefficient and factors affecting digestibility coefficient	2
9	Evaluation of protein value of feed	1
10	Evaluation of energy value of feed; TDN, SE and Partition of energy.	1
11	Storage, processing and mixing of diet and feed ingredients	1
12	Feeding management and nutrient requirement of ruminant	1
13	Feeding management and nutrient requirement of non-ruminant	1
14	Terminology of fodder and pasture production in Nepal	1
15	Factor affecting nutritive value of fodder	1
16	Classification of forage and anti-nutritional factors present in forage	1
17	Cultivation practices of important legumes and non-legumes including grasses; Perennial grasses: oat, jowar, bajra, teosinte, maize, berseem, lucerne and vetch	2
18	Cultivation practices of important legumes and non-legumes including grasses; Perennial grasses: guar, stylo, molasses, setaria, para, rhodes, napier, desmodium and comfrey	2
19	Alternative feeding resources in use and practice	1
20	Hay making and their importance	1
21	Silage making and their importance	1
22	Silvi-pastoral system and its importance	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of feed ingredients and fodder crops, grasses, legumes and tree fodders	1
2	Proximate analysis of feeds and fodder: DM, moisture and ash	1
3	Proximate analysis of feeds and fodder: CP, EE and CF	2
4	Computation of ration for cattle, buffalo, sheep and goat	1
5	Computation of ration for pig and poultry	1
6	Preparation of urea molasses mineral block and urea treated straw	1
7	Cultivation practices of annual and perennial grasses	2
8	Cultivation practices of annual and perennial legumes	2
9	Hay making	1
10	Silage making	1
11	Preparation of herbarium sheet of common fodder and forages species	1
12	Preparation of seasonal calendar for forage and fodder cultivation	1
	Total	15

Recommended Reading Materials

1. Banerjee, G.C. (2015). *A Text Book of Animal Husbandry (8th Edition)*. Oxford and IBH Publishing. New Delhi.
2. Banerjee, G.C. (2018). *Principles of Animal Nutrition and Feeds*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
3. Benerjee, G.C. (1986). *A Text Book of Animal Nutrition*. Published by Mohan Primlani. Oxford and IBH publishing Co. Pvt. Ltd., Bholanath Nagar, Delhi, India.
4. ICAR. (2016). *Handbook of Animal Husbandry*. Indian Council of Agriculture Research, New Delhi India.
5. Morrisison, F. B. (1984). *Feeds and Feeding*. C.B.S. Publishers and distributors. Jam Bhawan.
6. Pande, R S. (1997). *Fodder and Pasture Development in Nepal*. Udaya R D Service (P.) Ltd. Kathmandu Nepal.
7. Pandey, K.K. (1982). *Fodder Tree and Tree Fodder in Nepal*. Swiss Federal Institute of Forestry Research. Birmensdorf, Switzerland.
8. Pathak, N.N. and R C. Jakhmola. (1983). *Forage and Livestock Production*. Bikash publishing house. New Delhi.
9. Prasad, J. (2016). *Animal Husbandry and Dairy Science (6th Edition)*. Kalyani Publishers, New Delhi India.
10. Ranjhan, S.K. (1993). *Animal Nutrition in the Tropics*. Vikash publishing house Pvt. Ltd India.
11. Ranjhan, S.K. (1993). *Animal Nutrition and Feeding Practices in India*. Vikash Publishing House Pvt. Ltd India.
12. Sastry, N.R.S. and Thomas, C.K. (2018). *Livestock Production and Management (5th Edition)*. Kalyani Publication, New Delhi India.

Course Code	ASC621
Course Title	Fundamentals of Dairy Science and Technology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to collect samples, test quality, standardize milk and understand the processing of milk.
Course Description
Dairying in Nepal and comparison with developed countries; Definition of milk and diagrammatic representation of milk constituents; Composition and nutritive value of milk; physical and chemical properties of milk, factors affecting the composition of milk, clean milk production; Structure of mammary gland; Biosynthesis of milk and its constituents in brief; Hand milking and machine milking methods; Flavor defects in milk; Types of M.O. found in milk, sources of contamination and significance in dairy industry; Probiotic bacteria and their importance in human health; Definition of dairy technology and some related terminology; Milk

purchasing, collection system, preservation and safe transportation to the chilling center, receiving, weighing and sampling of milk; Different platform and routine tests, Straining, filtration, clarification and bacto-fugation of milk; Milk cooling system in Nepal and abroad; Milk homogenization and emulsification; Milk pasteurization, importance and methods; Milk sterilization and ultra-heat treatment and their importance; Milk packaging, storage and distribution systems in Nepal; Process of toning and standardization of market milk; Cleaning, sanitation and maintenance of dairy plant in brief.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Dairying in Nepal, its scope and comparison with developed countries	2
2	Definition of milk and diagrammatic representation of milk constituents	1
3	Composition of milk in brief (fat, lactose, protein, enzymes, vitamins and minerals)	2
4	Nutritive value of milk	1
5	Physical and chemical properties of milk	1
6	Factors affecting the composition of milk	1
7	Clean milk production and factors affecting clean milk production	1
8	Structure of mammary gland, external and internal features of mammary gland	1
9	Biosynthesis of milk and its constituents in brief	1
10	Hand milking and machine milking methods and their importance in dairy farms	1
11	Flavor defects in milk and their causes and prevention measures in brief	1
12	Types of micro-organism (OM) found in milk, their sources of contamination, uses and significance in dairy industry	2
13	Probiotic bacteria and their importance in human health	1
14	Definition of dairy technology and some related terminologies	1
15	Milk purchasing, collection system, preservation and safe transportation to the chilling center	2
16	Receiving, weighing and sampling of milk	1
17	Different platform and routine tests for maintenance of quality of milk	1
18	Straining, filtration, clarification and bacto-fugation of milk	1
19	Milk cooling system in Nepal and abroad	1
20	Milk homogenization and emulsification	1
21	Milk pasteurization, importance and explanation of methods with flow diagram	1
22	Milk sterilization and ultra-heat treatment, their importance and methods of heating	1
23	Milk packaging, storage and distribution systems in Nepal	1
24	Process of toning and standardization of market milk and problems related to it	2
25	Cleaning, sanitation and maintenance of dairy plant in brief	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study of commonly used dairy equipment in lab and commonly available dairy products in Nepal	1
2	Study of milk sampling procedures and sediment testing	1
3	Study of COB and ethyl alcohol test (ethanol) for checking suitability of the milk for further processing	1
4	Estimation of SP. Gr. SNF and T.S. in milk by using milk lactometer	1
5	Estimation of fat by Gerber's method	1
6	Study of MBR test for assessing microbiological quality of milk	1
7	Estimation of titrable acidity of milk by titration method	1
8	Estimation of total bacterial counts in milk using SPC method	1
9	Study of cream separator, their parts and assembling, and method of cream separation	1
10	Introduction (definition, nutritive values, uses and flow diagram of method of preparation) and preparation of concentrated dairy products (Ice cream and <i>Khoa</i>)	1
11	Introduction (definition, nutritive values, uses and flow diagram of method of preparation) and preparation of coagulated dairy products (Cheese, Chhena and Paneer)	1
12	Introduction (definition, nutritive values, uses and flow diagram of method of preparation) and preparation of fermented dairy products (Yoghurt and Probiotic milk products)	1
13	Introduction (definition, nutritive values, uses and flow diagram of method of preparation) and preparation of separated dairy products (Butter and Ghee)	1
14	Introduction (definition, nutritive values, uses and flow diagram of method of preparation) and preparation of dry milk product (Powder milk)	1
15	Study of common milk adulterants and their testing for safe milk production	1
	Total	15

Recommended Reading Materials

1. Banerjee, G.C. (2015). *A Text Book of Animal Husbandry (8th Edition)*. Oxford and IBH Publishing. New Delhi.
2. Chandan, R.C. and Arun, K. (2013). *Manufacturing Yoghurt and Fermented Milk (2nd edition)*. Willey-Blackwell Publication, USA.
3. Clarence, H.E., Combs, W. B. and Macy, H. (1994). *Milk and Milk Products*. TATA, McGraw-Hill Publishing Company Ltd, India.
4. Prasad, J. (2016). *Animal Husbandry and Dairy Science (6th Edition)*. Kalyani Publishers, New Delhi India.
5. Sukumar, De. (2000). *Outlines of Dairy Technology*. By Oxford University Press. New Delhi, India.

Course Code	ASC721
Course Title	Principle and Practices of Animal Breeding
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon completion of this course, the students will be able to understand basic principles and fundamentals of animal breeding and application of animal breeding techniques to improve the breeds of different species.

Course Description

Introduction, history and importance of animal breeding; Animal genetic resources and sustainable development of indigenous breeds; Importance of indigenous breed and economic values of cattle, buffalo, sheep, goat, pig, poultry and horse; Important economic traits of livestock and poultry; Variation and causes of variation; Importance of heredity and environment; Gene action (additive and non-additive); Concept of heritability and repeatability; Selection and mating system; Hormone and hormonal mechanism in growth, lactation and reproduction; Male and female reproductive system; Estrus, estrus detection, estrus cycle, estrus induction, estrus ovulation and synchronization. Artificial insemination (AI); Semen, method of semen collection, dilution, preservation and thawing; Synchronization and transfer of embryo and its importance; Embryo, embryo transfer, importance, techniques, super ovulation, collection, Transgenic animal and their production; Animal biotechnology and recent advances in animal biotechnology.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction, history and importance of animal breeding	1
2	Animal genetic resources and sustainable development of Nepal	1
3	Importance of indigenous breed and economic values of cattle, buffalo, sheep, goat, pig, poultry and horse	1
4	Important economic traits of livestock and poultry	1
5	Variation and causes of variation	2
6	Importance of heredity and environment	1
7	Gene action (additive and non-additive)	2
8	Concept of heritability and repeatability	2
9	Selection (principle, basis, method, selection parameters)	3
10	Mating system (inbreeding, out breeding)	2
11	Hormone and hormonal mechanism in growth, lactation and reproduction	2

12	Male and female reproductive system	1
13	Estrus, estrus detection, estrus cycle, estrus induction and estrus, ovulation, synchronization	3
14	Artificial insemination (AI): Introduction, advantages and limitation and techniques of AI	1
15	Semen, method of semen collection, dilution, preservation and thawing	2
16	Synchronization and transfer of embryo and its importance	1
17	Embryo, embryo transfer, importance, techniques, super ovulation, collection	2
18	Transgenic animal and their production	1
19	Animal biotechnology and recent advances in animal biotechnology	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Estimation of heritability	1
2	Estimation of repeatability	1
3	Estimation of variance components, means	1
4	Breeding value, PBA, MPPA	2
5	Calculation of inbreeding relationship and coefficient	1
6	Livestock farm data analysis and report writing	1
7	Estimation of selection parameters, selection index etc.	2
8	Heat detection in different farm animals	1
9	Palpation of female reproduction organ	1
10	Preparation of A. V.	1
11	Collection of semen and evaluation	1
12	Dilution and preservation of semen	1
13	Heat detection and semen thawing and insemination	1
	Total:	15

Recommended Reading Materials

1. Hafez, E.S.E. (1989). *Reproduction in Farm Animal - 5th edition*.
2. Nagabhushanam, R., Kodarkar, M.S. and Sarojini, S. (1999). *A Text Book of Animal Physiology 2nd ed.* Oxford and IBH Publishing Co. Pvt. Ltd. 66, Janpath, New Delhi.
3. Nicholl, D.S.T. (1994). *An Introduction to Genetic Engineering*. Cambridge, UK.
4. Prasad, J. (2016). *Animal Husbandry and Dairy Science (6th Edition)*. Kalyani Publishers, New Delhi India.
5. Sastry, N.R.S. and Thomas, C.K. (2018). *Livestock Production and Management (5th Edition)*. Kalyani Publication, New Delhi India.
6. Satisfury, G.W., M.L.Vandam-Mark and J.R. Lodge. (1988). *Physiology of Reproduction and Artificial Insemination of Cattle*. W. H. Freeman and Company Sanfrancisco, US.
7. Stickberger, M.W. (1985). *Genetics - 3rd edition*. MillanPubi., Co. USA

Aquaculture

Course Code	AQU321
Course Title	Fundamentals of Ichthyology and Limnology
Credit Hours	3(2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to understand the basic concept of ichthyology and limnology, external morphology of fish, different internal organs, branches of limnology, and aquatic biodiversity of Nepal.
Course Description
Introduction of ichthyology and limnology; Taxonomical classification and characteristics of major fishes of Nepal; Morphology of fish; Different organ systems, structures and functions; Inland water resources in Nepal; Branches of limnology; Aquatic biodiversity; Human impact on lake-ecosystem and Aquatic Animal Protection Act 2017.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1.	Introduction	
1.1	Brief description of fish, ichthyology, limnology, inland water, and other terminology; General characteristic of fish	1
1.2	Scope and importance of limnology	1
2.	Taxonomical Classification and Characteristics of Major Fishes of Nepal	
2.1	Systematic classification of fish with distinguishing characteristic of each level (up to order)	1
2.2	Brief description of major classes of fish: Elasmobranchii, Holocephali (Chondrichthyes), Dipnoi, Teleostomi (Osteichthyes)	1
2.3	Characteristics of economically important indigenous and exotic species of fish of Nepal	
2.3.1	Chinese carps: Silver carp (<i>Hypophthalmichthys molitrix</i>), Bighead carp (<i>Hypophthalmichthys nobilis</i>) and Grass carp (<i>Ctenopharyngodon idellus</i>)	1
2.3.2	Indian major carps: Catla/Bhakur (<i>Catla catla</i>), Rohu (<i>Labeo rohita</i>) and Naini/ Mrigal (<i>Cirrhinus mrigala</i>)	1

2.3.3	Common carp: <i>Cyprinus carpio var. communis</i> and <i>Cyprinus carpio var. specularis</i> ; Nile tilapia (<i>Oreochromis niloticus</i>); Rainbow trout (<i>Oncorhynchus mykiss</i>)	1
2.3.4	Mangur/Walking catfish (<i>Clarias gariepinus</i>); Pangasius/Baikhi /sutchi catfish (<i>Pangasius hypophthalmus</i>); Silver barb (<i>Puntious gonionotus</i>) Sahar/Golden mahseer/ Pahele sahar (<i>Tor putitora</i>)	1
3.	Morphology of Fish	
3.1	Body division and body shape- Brief description on body division: head, trunk and tail; Brief description of shape and form of fish: Flat or Depressiform, Filliform, Fusiform, Compressiform, Sagittiform Taeniform, Globiform and Anguilliform; Brief description on external organs of fish: mouth (superior, inferior, sub terminal), snout, nostrils, eyes, barbells, operculum lateral line, fins and vent	1
3.2	Fins: Introduction; Types of fins: Paired fins- pelvic fin and pectoral fin: Unpaired fins- anal fin, dorsal fin, adipose fin and caudal fin; Origin of fins: gill arch theory and fin fold theory	1
3.3	Fin rays; Types of caudal fin: Protocercal caudal fin, Heterocercal caudal fin and Homocercal caudal fin; Function of fins	1
3.4	Skin: Introduction; Structure of skin: epidermis layer of skin in fish (mucous gland, poison gland, photophores) and dermis layer of skin in fish; Function of skin	1
3.5	Scales: Introduction; Brief description on different types of scales: Cosmoid scales, Ganoid Scales and Leptoid scales (Cycloid scales and Ctenoid scales); Function of scales	1
3.6	Coloration in fish- Sources of color: Melanophores, Iridophores, Xanthophores and Erythrophores; Mixed coloration in fish; Color change in fish; Significance of coloration	1
4.	Different Organ Systems: Structure and Functions	
4.1	Digestive system: Food and feeding habits of fish; Relative gut length; Structure and function of alimentary canal: mouth and pharynx, esophagus, stomach, small intestine, large intestine, cloaca and other associated gland	1
4.2	Digestive glands: Liver, pancreas and other glands; Mechanism of digestion: ingestion, digestion, absorption and excretion	1
4.3	Respiratory system	
4.3.1	Respiratory track; Structure of gill: Gill arch, gill racker, gill filaments, pseudobranch and function of gills; Mechanism of respiration	
4.3.2	Accessory respiratory organ in fish- Brief description on different accessory respiratory organ in fish: Buccopharyngeal epithelium, skin, opercular lungs, labyrinthine organs, pharyngeal lungs, air bladder/ swim bladder; Functions of accessory respiratory organ; Significance of accessory respiratory organs	1
4.4	Reproductive system	

4.4.1	Modes of reproduction in fishes: Gonochoristic, Hermaphroditic, Parthenogenetic; Male reproductive organ; Seasonal changes in the testis; Female reproductive organ; Seasonal changes in the ovary	1
4.4.2	Mechanism of gonad development: Spermatogenesis, Oogenesis, Sexual dimorphism; Functions of gonads	1
5.	Inland Water	
5.1	Types of inland waters: Lotic water and lentic water; Origin and classification of water bodies: rivers, lakes, pond, stream, and wetland	1
5.2	Major rivers and freshwater lakes of Nepal: Brief description on major rivers and freshwater lakes of Nepal; Scope of fresh water fisheries in Nepal; Challenges of fresh water fisheries in Nepal	1
6.	Branches of Limnology	
6.1	Physical parameters of limnology- Lake stratification and turn over: Epilimnion, Metalimnion, Hypolimnion, Thermocline; Brief description on different types of lake; Holomictic lake: Oligomictic, Monomictic, Dimictic, Polymictic; Meromictic lake; Amictic lake	1
6.2	Chemical elements and compounds in the lakes and their role in a lake ecosystem; Dissolve oxygen, pH, temperature	1
6.3	Biological limnology- Aquatic ecology and food web: Energy movement in the aquatic ecosystem; Planktons- phytoplanktons and zooplanktons; Food chain and food webs in the lakes: producer, consumers (primary consumer, secondary consumer), and scavengers	1
6.4	Brief description on lake zonation: littoral zone, limnetic zone, profundal zone; Brief description on productivity of lake : Oligotrophic lake, Mesotrophic lake, Eutrophic lake	1
7.	Aquatic Biodiversity	
7.1	Introduction; Brief description on status of aquatic biodiversity of Nepal	1
7.2	Importance of aquatic biodiversity; Threats to Aquatic Biodiversity; Conservation Approaches	1
8.	Human Impact on Lake Ecosystem	
8.1	Source of threats; Method and action for improvement of lake status	1
9.	Aquatic Animal Protection Act, 2017 (1960)	
9.1	Introduction; Objective; Provisions in the law	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study of the external morphology of fish	1
2	Study of the internal anatomy of fish	1
3	Sample collection and identification of fish species	2
4	Identification of different types of scales present in teleost	1
5	Identification and study of fish mouth types and their function	1
6	Morphometric measurement of fish	1

7	Study of the accessory respiratory organ of Mangur (<i>Clarius batrachus</i>)	1
8	Study of gills of fish	1
9	Sex determination in fish	1
10	Collection and identification of aquatic plants from different fresh water bodies	2
11	Determination of sexual maturity of brood fish for induced spawning	2
12	Basic diagnosis of diseased fish	1
	Total	15

Recommended Reading Materials

1. Biswas, S.P. (2002). *Fundamentals of Ichthyology*. India: Narendra Publishing House.
2. Gupta, R.K. (2007). *Fundamentals of Ichthyology*. India: Daya Publishing House.
3. Kapoor, B.G., and Khanna, B. (2004). *Ichthyology Handbook*. New Delhi: Narosa Publishing House.
4. Khanna, S.S., and Singh, H. R. (2014). *A Text Book of Fish Biology and Fisheries*. India: Narendra Publishing House.
5. Monson, B. (1992). *A primer on limnology* (2nd ed.). Water Resources Center.
6. Shrestha, T.K. (2008). *Ichthyology of Nepal: A Study of Fishes of the Himalayan Waters*. U.K: Himalayan Ecosphere.
7. Tundisi, J. G., and Tundisi, T. M (2012). *Limnology*. CRC Press.
8. Wetzel, R. G. (2001). Lake and River Ecosystems. *Limnology* (3rd ed., pp. 1006). Academic Press.

Course Code	AQU421
Course Title	Fundamentals of Aquaculture
Credit Hours	3(2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of the course, the students will be able to explain about cultivable and cultivated fish species, culture units and construction, principles and practices of culture systems, various management required, disease control and post-harvest handling of fish.

Course Description

Definitions and importance of aquaculture; History of aquaculture in Nepal; Site selection and pond construction, pond management; Food and feeding; Water quality; Various fish farming systems; Fish breeding, nursing and rearing; Common fish diseases and parasites; Post-harvest technology.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1.	Introduction	
1.1	Brief description on fisheries, aquaculture, capture fisheries, culture based	1

	fisheries and enhanced fisheries; Definition of terminologies used in aquaculture	
1.2	Importance of aquaculture: Economic social, nutritional, environmental; Desirable characters of fish for culture	1
2.	Pond Construction	
2.1	Criteria for site selection , soil quality test	1
2.2	Brief description on different types of pond used in aquaculture: One the basis of construction, use, topography and enclosure	1
2.3	Pond layout and brief description on its parts	
2.4	Steps in pond construction, optimum depth and size of different types of pond	1
3.	Pond Management	
3.1	Techniques used for pond management; Pond liming: Lime cycle, advantages of liming, chemicals used for liming, Method and dose, timing for lime application, neutralizing value of lime	1
3.2	Pond fertilization: Brief description, fertilizer dose, types of fertilizer with their advantages and disadvantages, and their application methods	1
3.3	Brief description of feed; Brief description on different types of natural and formulated feed; Brief description on feed formulation, rate, time and methods of feeding; Precaution during fish feeding	1
3.4	Aquatic weed: Brief description, classification of aquatic weed, control of aquatic weed; Brief description and methods for removal of predatory and weed fish; Commonly used piscicides; Recent concept on weed fish	1
4	Water Quality Management	
4.1	Physical parameters-Temperature: Thermal stratification; Diel fluctuation of temperature in fish pond; Effect of water temperature on fish growth; Temperature management on fish pond	1
4.2	Physical parameters-Turbidity: Brief description; Types of turbidity; Effects of turbidity; Measurement of turbidity: Secchi disk visibility method; Measures to control pond turbidity	1
4.3	Chemical parameters- Dissolve Oxygen (DO): Brief description; Fluctuation of oxygen level in pond: Diel and seasonal fluctuation; Sign and symptoms of dissolve oxygen depletion; Preventive measure and solution for maintaining dissolve oxygen in pond; Measurement of dissolve oxygen in pond (Instrumental method)	1
4.4	pH: Brief description; Diel fluctuation of pH in fish pond; Effect of pH on fish; Measurement of pH; pH management in fish pond	
	Biological parameters- Planktons: Types of plankton in aquatic environment; Brief description on planktons present aquatic environment; Role of planktons in fish production	1
5.	Fish Farming Systems (FFS)	
5.1	Introduction; Classification of FFS: Description of fish farming system on the basis of intensity with their advantages and disadvantages; Extensive fish farming, semi intensive fish farming	1

5.2	Description of fish farming system on the basis of enclosure: Cage culture and pen culture; Cage culture: Description, site selection, characteristics of fish for cage culture; Types of cage used with brief description; Species stocked and stocking densities; Advantages and disadvantages; Management practices of cage fish culture; Pen culture- Description; Advantages and Disadvantages; Difference between cage fish farming and pen fish farming	1
5.3	Description of fish farming system on the basis of fish species with their advantages and disadvantages: Monoculture, Polyculture, and their differences	1
5.4	Description of fish farming system on the basis of integration: Rice fish farming, horticulture fish farming and livestock fish farming; Basic principle of integrated fish farming system; Advantages of integrated fish farming system	1
5.5	Rice fish farming: Background; Site selection; Construction of refuge in rice fish farming; Characteristic of rice variety to be cultivated; Fish species and their stocking rate; Feed and fertilizer; Care and management; Harvesting; Advantage and disadvantages	1
6.	Fish Breeding	
6.1	Brood fish management- Selection of broodstock; Sex differentiation; Source of broodstock; Criteria of good broodstock pond; Segregation of broodstock; Stocking density; Feeding and Care of broodfish	1
6.2	Brief description on different types of breeding methods: Natural breeding, semi-artificial breeding and induced breeding; Method of injecting hormone to broodfish; Description of hormones used for artificial spawning: Pituitary gland extract, Human chorionic gonadotropin hormone and Ovaprim	1
6.3	Favorable environment required for successful egg development; Characteristics of good and bad egg; Breeding of common carp, Brief description on Natural breeding; Semi artificial breeding- brief description; Natural condition required to bring spawning; Kakaban; Hatching time and latency period; Brief description and steps involved in artificial breeding	1
6.4	Breeding of Chinese carp- Short notes and steps involved in natural semi artificial and artificial breeding of Chinese carp; Breeding of Indigenous major carps; Short notes and steps involved in natural, semi artificial and artificial breeding of Indian major carps	1
7.	Transportation of Fish Seed	
7.1	Stage of fish for transportation; General guidelines for fish seed transportation; Cause of mortality during fish seed transportation	1
7.2	Conditioning of fish seed before transportation; Method of fish seed packing and transportation: Open and closed system of transportation; Chemical used in fish transportation	1
8.	Common Fish Diseases and Parasites	
8.1	Brief description on fish disease and parasite; Causes of fish disease; Common sign and symptoms	1

8.2	Diagnosis of fish disease: History taking, environmental study, body examination, postmortem examination and laboratory examination; Types of fish diseases: Brief description of Infectious and Non-infectious disease	1
8.3	Non-infectious disease: Cause, symptom, prevention and treatment of Asphyxiation and Gas bubble disease	
8.4	Infectious disease: Causal organism, environment requirement, symptom and control measure of Fungal disease: Saprolegneiasis/water mould disease	1
	Causal organism, environment requirement, symptom and control measure of Bacterial disease: Tail or fin rot disease	
8.5	Causal organism, environment requirement, symptom and control measure of Parasitic disease: Protozoan disease (White spot disease); Disease caused by Monogenetic trematode (Gyrodactylosis and Dactylogyrosis); Crustaceans (fish lice)	1
9.	Post-Harvest Technology	
9.1	Introduction and importance of post-harvest technology; Practices for maintenance of quality of fish during post-harvest handling: initial handling, on board storage	1
9.2	Techniques for post-harvest storage: Low temperature storage (chilling, super chilling, and freezing); High temperature storage (smoking, drying, brine salting, curing, and canning)	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of different equipment's used in fish culture and breeding	1
2	Observation of pond types and measurements of a typical pond with its parts	1
3	Pond liming and fertilization	1
4	Water quality measurements (temperature, transparency, Dissolve oxygen and pH)	2
5	Identification of different types feeds used for feeding fish	1
6	Identification of different types of net used in fishing	1
7	Common Carp breeding	1
8	Fry nursing and transportation	1
9	Identification of fresh and spoiled fish	1
10	Common drugs and chemicals used in fish disease treatment	1
11	Preparation of Kakaban for fish breeding	1
12	Preparation of fish feed	1
13	Fish farm visit and preparation of report	2
	Total	15

Recommended Reading Materials

1. Biswas, K.P. (2014). *Fish Processing and Preservation*. Daya Publishing House, India
2. ICAR. (2006). *Handbook of Fisheries and Aquaculture*. New Delhi: Indian Council of Agricultural Research (ICAR).

3. Jhingran, V.G. and R.S.V. Pullin. (1985). *A Hatchery Manual for the common, Chinese and Indian Major Carps*. Manila, Philippines: Asian Development Bank, ICLARM.
4. NACA. (1989). *Integrated Fish Farming in China Technical Manual*. Bangkok, Thailand: A World Food Day Publication of the Network of Aquaculture Centre in Asia and the Pacific.
5. Shrestha M.K. and Jha, D.K (1993). *Introduction to Fish Culture*. Rampur, Chitwan, Nepal: Institute of Agriculture and Animal Science.
6. Shrestha, M.K. and Pandit, N.P. (2012). *A Text Book of Principles of Aquaculture* (2nd ed.). Rampur, Chitwan, Nepal: Aquaculture Department, Institute of Agriculture and Animal Science.
7. Woynarovich, E. (1975). *Elementary Guide to Fish Culture in Nepal*. Rome Italy: FAO.
8. Woynarovich, E. and Horvath, L. (1984). *The Artificial Propagation of Warm Water Finfishes: A Manual for Extension*. FAO fisheries technical paper. 20

Basic Science

Course Code	BCH121
Course Title	Fundamentals of Biochemistry
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of his course, students will be able to understand the basics of biomolecules, their composition and functions as well as various biochemical process that takes place in living beings.

Course Description

Importance of biochemistry; Water, pH and buffer (biological buffers); Nomenclature and classification of enzymes, classification, structure and function of important bio-molecules; Metabolism of important bio-molecules, central metabolic pathways, and introduction to polymerase chain reaction.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction: Introduction, history, scope and practical significance of biochemistry in agriculture	1
2	Water, pH and Buffers	
2.1	Ionization of water; Acid and base (Arrhenius, Bronsted- Lowry, Lewis concept); Dissociation constant.	1
2.2	Buffer system and importance of biological buffer system	1
3	Biomolecules and the Cell (prokaryotic and eukaryotic cells)	1
4	Carbohydrates	
4.1	Definition and classification of carbohydrates on the basis of hydrolysis, reducing behavior and solubility and functions of carbohydrates	1
4.2	Structure, physical and chemical properties of carbohydrates	1
4.3	Biosynthesis of sucrose, starch and glycogen	1
4.4	Biodegradation of sucrose, starch and glycogen	1
5	Lipids	
5.1	Definition, structure, functions and classification of fatty acids	1
5.2	Definition, functions and classification of lipids	1
5.3	Biosynthesis of triacylglycerides	1
5.4	Biodegradation of triacylglycerides	1
6	Amino acids and Proteins	
6.1	Definition, structure, properties and functions of amino acids	1
6.2	Peptide bond: Classification of proteins on the basis of functions; Structural	1

	organization of proteins	
6.3	Overview of amino acid biosynthesis	1
6.4	Degradation of amino acids	1
6.5	Transamination, deamination, trapping of ammonia and its detoxification	1
7	Nucleic Acids	
7.1	Nitrogenous bases (purines and pyrimidines), nucleoside, nucleotides with structure	1
7.2	Structure, functions and types of nucleic acid (DNA and RNA), Watson and Crick model of DNA	1
7.3	Types of RNA: mRNA, tRNA, rRNA, hnRNA	1
7.4	Replication and transcription of DNA	1
7.5	Translation and termination	1
8	Enzymes	
8.1	Terminologies, nomenclature and classification of enzymes.	1
8.2	Mechanism of enzyme action; Michaelis Menten equation-its significance	1
8.3	Factors affecting enzyme activity and enzyme specificity	1
9	Metabolic Pathways	
9.1	Biochemistry of glycolysis, fate of pyruvate	1
9.2	Biochemistry of TCA cycle, amphibolic nature of TCA cycle	1
9.3	Site, process and significance of pentose phosphate pathways	1
10	Electron Transport Chain	
10.1	Enzymes involved in oxidation-reduction; electron carriers; oxidative phosphorylation	1
10.2	Shuttle system involved in ETC; inhibitors of ETC	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Introduction and uses of laboratory equipment and glass wares and lab safety	1
2	Preparation of standard solution (normal, molar and molal)	1
3	Preparation of buffer solution (acetate buffer, phosphate buffer)	1
4	Detection of carbohydrate by Molisch and Anthrone tests	1
5	Detection of amino acids by Millon's test and Ninhydrin test	1
6	Detection of protein by Biuret test	1
7	Saponification of fat	1
8	Enzymatic actions of potato oxidase, urease and catalase	1
9	Quantitative estimation of reducing sugar in the provided sample	1
10	Quantitative estimation of proteins in the provided sample	1
11	Demonstration of differential centrifugation	1
12	Demonstration of gel electrophoresis	1
13	Demonstration of paper chromatography	1
14	Demonstration of Spectrophotometry and Colorimetry	1

15	Preparation of tissue culture media	1
	Total	15

Recommended Reading Materials

1. Basnet, R. C. (2004). *Textbook of Biochemistry*. Sewa Printing Press, Kathmandu.
2. Lehninger, A. L., Nelson, D. L. and Michael, M. C. (1993). *Principles of Biochemistry*. CBS Publishers and Distributors, New Delhi, India. M. C.
3. Mu, P. and Plummer, D. T. (2001). *Introduction to Practical Biochemistry*. Tata McGraw-Hill Education, India.
4. Rameshwar, A. (1993). *Practical Biochemistry: A Basic Course*. Kalyani Publication, New Delhi, India.

Course Code	CPH221
Course Title	Fundamentals of Crop Physiology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

To impart fundamental knowledge of crop physiology so that the students will understand the general principles and process of crop physiology, the effect of different factors on growth and development of plants and know about plant soil relations.

Course Description

Introduction and importance of crop physiology, concept of plant cell structure and function; Laws of thermodynamics; Diffusion and osmosis; Concept of water potential and water use efficiency; Absorption of water, transpiration and stomatal physiology; Ascent of sap; Mineral nutrition and absorption; Process of photosynthesis and respiration; Translocation of photosynthates; Production of secondary metabolites; Seed germination, dormancy, photoperiodism and vernalization; Process of growth and development in plants; Structure, physiology roles and application of phyto-hormones; Physiological parameters influencing growth and yield of crops.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction: Introduction and importance of crop physiology in agriculture	1
2.	Cell Physiology	
2.1	Overview of a typical plant cell structure	1
2.2	Structure and function of cell organelles	1
3.	Bioenergetics and Biophysical Phenomenon in Plants	
3.1	Laws of thermodynamics and their application in biological world	1
3.2	Process of diffusion and osmosis and their significance in plant life.	1
3.3	Concept of water potential and water use efficiency in plants	1
4.	Absorption of Water and Ascent of Sap	
4.1	Absorption of soil water by plant and factors affecting it	1

4.2	Transpiration and stomatal physiology	1
4.3	Ascent of sap	1
5	Absorption of Nutrients in Plants	
5.1	Physiological functions of nutrients in plants	1
5.2	Ion uptake by roots, mechanism and factors affecting it	1
5.3	Overview of foliar nutrition and factors affecting it	1
6	Photosynthesis	
6.1	Introduction, light reaction (cyclic and non-cyclic photo phosphorylation) and C ₃ cycle	1
6.2	Photorespiration and C ₄ cycle	1
6.3	CAM cycle and factors affecting photosynthesis	1
7	Respiration	
7.1	Types of respiration: aerobic/anaerobic, salt respiration, wound respiration	1
7.2	ATP budget of respiration; Factors affecting respiration	1
8	Translocation of Photosynthetic Products	
8.1	Anatomy of phloem, source and sink concept	1
8.2	Phloem loading and unloading, factors affecting translocation of photosynthetic products	1
9	Secondary Metabolites	
9.1	Introduction to various secondary metabolites: alkaloids, terpenoids and phenolic compounds	1
9.2	Role of secondary metabolites in plant defense	1
10	Physiology of Growth and Development in Plants	
10.1	Growth, development and differentiation; Apoptosis, plasticity and heterophyly in plants	1
10.2	Phases of growth; Factors affecting growth	1
11	Seed Germination and Dormancy	
11.1	Concept and types of seeds germination; Physiological and biochemical changes during seed germination, factors affecting germination	1
11.2	Seed dormancy, types, causes and removal of seed dormancy	1
12	Physiology of Flowering	
12.1	Various theories of flowering	1
12.2	Photoperiodism and vernalization	1
13	Phytohormones	
13.1	Classification, occurrence and biosynthesis of auxin, gibberellin, cytokinin, ABA and ethylene.	1
13.2	Physiological role and mode of actions of auxin, gibberellin, cytokinin, ABA and ethylene	1
14	Physiological Parameters Influencing Growth and Yield in Crop Plants	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Introduction to equipment and chemicals used in crop physiology lab	1
2	Demonstration of DPD by gravimetric method	1
3	Separation of plant pigments by paper chromatography	1
4	Demonstration of transpiration by cobalt chloride and bell jar method	1
5	Extraction of chloroplast pigments from leaves	1
6	Estimation of water potential by Chardakov's method	1
7	Effect of light and CO ₂ on the process of photosynthesis	1
8	Demonstration of aerobic respiration in plants	1
9	Study the field symptoms of essential macro and micro mineral elements in crop plants	1
10	Study of structure and distribution of stomata in monocot and dicot leaves	1
11	Study of anatomy of C ₃ and C ₄ plant leaves	1
12	Germination under different moisture and temperature regime	1
13	Study effect of Gibberelic acid on seed germination	1
14	Leaf area measurement and calculation of leaf area index	1
15	Calculation of various growth and yield parameters of agricultural crops	1
	Total	15

Recommended Reading Materials

1. Devlin, R. M. and Witham, R. H. (1986). *Plant Physiology*. CBS Publication and Distribution, India.
2. Gupta, U. S. (1978). *Crop Physiology*. Oxford and IBH Publishing Co. Ltd., New Delhi, India.
3. Meye, B. S., Anderson, D. B., Bohning, R. N. and Fratianne, D.G. (1973). *Introduction of Plant Physiology*. D. Van Nostrand Co., New York, US.
4. Salisbury, F. B. and Ross, C.W. (2010). *Plant Physiology*. Wordsworth Publishing Company, California, USA.
5. Saxena, S. K. (1995). *Modern Practicals in Plant Physiology and Biochemistry*. CBS Publication and distribution, New Delhi, India.
6. Taiz, L. and Zeiger, E. (2010). *Plant Physiology (6th edition)*. Sinauer Associates Publisher, Sunderland.

Course Code	MBI321
Course Title	Fundamentals of Microbiology and Biotechnology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, students will:
 Learn the basic concept of agricultural microbiology, useful and harmful microbes in agriculture and role of microorganisms in maintaining crop productivity and soil fertility, and
 Understand the basics of biotechnologies, area and scope of biotechnology as well as various techniques that are used in biotechnology.

Course Description

Introduction, scope, importance and practical application of microbiology in agriculture; Comparison between prokaryotic and eukaryotic microorganisms; Role of microorganisms in soil fertility and crop production; Relationships of microorganisms and plants; Biodegradation and bioremediation of agrochemicals; Microbial degradation of organic residues; Plant pathogenic microorganisms; Food microbiology, microorganisms in human welfare; Introduction of biotechnology; Types and techniques of in-vitro cultures; Outlines of basic steps involved in plant biotechnology/ genetic engineering; Gene transfer; Marker assisted selection and its application in plants; DNA finger printing; Mapping quantitative traits locus in agriculture.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction to Microbiology and Microorganisms	
1.1	Introduction, historical development, scope and importance of microbiology	1
1.2	Basic characteristics of prokaryotic and eukaryotic microorganisms	1
2	Role of Microorganisms in Soil Fertility and Crop Production	
2.1	Role of microorganisms in formation of soil organic matter, factor influencing the activity of soil microorganisms	1
2.2	Rhizosphere and phyllosphere effects of microorganisms	1
2.3	Different types of plant microbes interaction	1
2.4	Biological nitrogen fixation: types of biological nitrogen fixation	1
2.5	Mechanism of formation of nodules and symbiotic nitrogen fixation by <i>Rhizobium</i>	1
2.6	Basic concept on phospho bacteria and mycorrhizae	1

3	Plant Pathogenic Microorganisms: Signs and symptoms of plant diseases; Disease triangle; Various plant diseases with their causative agents	1
4	Biodegradation	
4.1	Aerobic and anaerobic degradation of carbohydrates, fats and proteins	1
4.2	Concept, principles and processes of bioremediation	1
4.3	Microbial degradation of pesticides and other agrochemicals	1
5	Food Microbiology: Microbial spoilage of foods and toxins produced; Principles of food preservation	1
6	Microorganisms in Human Welfare	
6.1	Importance and mass production of microbial bio-fertilizers; Microbial bio-pesticides, role of microorganisms in compost making	1
6.2	Alcohol fermentation; Effluent management and water purification; Biogas production, antibiotics	1
7	Biotechnology	
7.1	Introduction, definition, scope, importance of biotechnology in agriculture and other disciplines	1
7.2	History of plant tissue culture and genetic engineering; Concept of totipotency	1
8	Types and Techniques of <i>in-vitro</i> Cultures	
8.1	Types of <i>in-vitro</i> cultures in plants	1
8.2	Nutritional requirements of <i>in-vitro</i> cultures	1
8.3	Factors affecting <i>in-vitro</i> cultures; Application and achievements	1
9	Outlines of Basic Steps Involved in Biotechnology / Genetic Engineering	
9.1	Isolation of DNA	1
9.2	Restriction of DNA by endonucleases	1
9.3	Electrophoresis of restricted DNA fragments	1
10	Gene Transfer	
10.1	Vectors for gene transfer	1
10.2	Direct and indirect methods of gene transfer	1
10.3	Application of transgenic plants	1
10.4	Somaclonal and gametoclonal variation in plants	1
11	Marker assisted selection and its application	1
12	DNA finger printing	1
13	Mapping quantitative traits locus in agriculture	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Elementary knowledge of instruments used and requirement in Plant Biotechnology	1
2	Media preparation for Embryo culture	1
3	Media preparation for Anther culture	1
4	Media preparation for Ovule culture	1
5	Sterilization techniques and inoculation of explants	1

6	Aseptic manipulation of explants	1
7	Callus induction and plant regeneration	1
8	Anther, embryo and endosperm culture	1
9	Demonstration and isolation of nucleic acids	1
10	Isolation of protoplast	1
11	Demonstration and culturing of protoplast	1
12	Demonstration of direct methods of gene transfer techniques	1
13	Demonstration of indirect methods of gene transfer techniques	1
14	Demonstration of gel electrophoresis techniques	1
15	Demonstration of DNA finger printing	1
	Total	15

Recommended Reading Materials

1. Cappuccino, J. G. and Sherman, N. (2010). *Microbiology (A Lab manual) - 7th Ed.* Benjamin Cumming, New York, USA.
2. Pelczar, M. J., Chan, E.C.S, and Kreig, N. R. (1986). *Microbiology.* McGraw-Hill publishers.
3. Bagyaraj, D. J. and Rangaswami, G. (2007). *Agricultural microbiology.* PHI Learning Pvt. Ltd.
4. Saxena, N.P. and Awasthi, D. K. (2003). *Microbiology.* Krishna Prakashan Media Pvt. Ltd. Meerut, India.
5. Singh, R. P. (2012). *Microbiology.* Kalyani Publishers. New Delhi, India.
6. Ignacimuthu, S. (1996). *Basic Biotechnology.* Tata McGraw Hill Publishing Company Ltd., India.
7. Pareek, L. K. and P. L. Swarnkar. (1997). *Trends in Plant Tissue Culture and Biotechnology.* Agro Botanical Publishers, India.

Course Code	AST621
Course Title	Agricultural Statistics and Computer Technology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to use different statistical tools used in designing experiments, data analysis and report preparation using advanced computer technologies.
Course Description
An overview of statistics; Sampling methods; Measures of central tendency; Frequency distribution, presentation and summarization of data; Measures of dispersion; Probability and probability distributions; Correlation and regression; Test of significance - Z-test, t-test, X ² -test; Analysis of variance, one-way and two-way and factorial experiments; Introduction and application of various latest computer technologies.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	
1.1	Introduction to statistics, definitions, scope and limitations, advanced computer technologies in agricultural statistics	1
2	Population and Sampling	
2.1	Definition of a population; Sample: characteristics of a good sample, sampling methods, simple random sampling	1
2.2	Sample selection from an agricultural field by simple random sampling	1
2.3	Probability proportional to size- stratified random sampling, systematic sampling, cluster sampling, multistage sampling, sampling error	1
3	Measures of Central Tendency	
3.1	Definition of arithmetic mean, median and mode	1
3.2	Merits, demerits and uses of variables of central tendency, properties of an ideal measure of central tendency, partition values: quartiles, deciles and percentiles	1
4	Frequency Distribution	
4.1	Presentation and summarization of data by different classification methods: Exclusive and inclusive; Diagrammatic Bar and Pie charts and graphical methods	1
4.2	Histogram, Frequency polygon, Frequency curve, Ogives (cumulative frequency curves)	1
5	Measures of Dispersion	
5.1	Range, Quartile deviation, Mean Deviation, Standard Deviation and Variance, Coefficient of variation	1
5.2	Moments: raw moments and central moments for grouped and ungrouped data, Relationship between raw moments and central moments	1
5.3	Measures of skewness and kurtosis	1
6	Probability and Probability Distributions	
6.1	Definitions of random experiment, sample space, events: independent and dependent, trial, mutually exclusive events, exhaustive events, equally likely events, simple and compound events	1
6.2	Definitions of probability (classical and statistical), simple problems based on probability, addition and multiplication theorems, conditional probabilities	1
6.3	Probability distributions: Binomial distribution, properties and problems; Poisson distribution, its properties and problems; Normal distribution with its properties and problems; Sampling distributions of mean and differences	1
7	Correlation and Regression	
7.1	Definition, types of correlation, scatter diagram; Karl Pearson's coefficient of correlation (linear correlation), properties, correlation coefficient for bivariate frequency distribution, test for correlation coefficient	1
7.2	Regression (linear), Regression equations of y on x and of x on y, Relation between correlation coefficient and regression coefficients	1

8	Test of Significance	
8.1	Introduction, definition of hypothesis, null and alternative hypotheses, degrees of freedom, levels of significance and types of error	1
8.2	Significance of means: one sample and two sample mean in large samples (Z-test)	1
8.3	Significance of means in small samples (t-test), one sample, two samples and two related samples mean test (paired t-test), F-test, X^2 (chi-square) test; Test of independence and goodness of fit	1
9	Principles and Practices of Field-plot Experimentation and Design	
9.1	Replication, Randomization, Local control	1
9.2	One way analysis of variance (Completely Randomized Design)	1
9.3	Two-and three-ways analysis of variance (Randomized Block Design, and Latin Square Design)	1
9.4	Confounding and Factorial experiments (2^2 and 2^3) with split and strip plot designs	1
10	Computer Technologies in Agriculture Statistics	
10.1	Introduction to IT/ ICT use in agriculture, graphics in computer	1
10.2	Microsoft Excel, statistical programs/packages for social and biological sciences	1
10.3	Using Mobile apps in agriculture for farm advices, market price determination, post-harvest management etc.	1
10.4	Preparation of contingent crop planning and crop calendar using ICT tools	1
10.5	Computer models in agriculture; statistical, weather analysis and crop simulation, IT/ICT application for water and nutrient requirement	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Central tendency for ungrouped and grouped data (Arithmetic Mean, Median, Mode, Quartiles, Deciles, and Percentiles)	1
2	Classification of data by Exclusive and Inclusive methods; Diagrammatic representation of data by Bar and Pie charts	1
3	Cumulative frequency table from raw data and its graphical representation (Histogram, Frequency Polygon, Frequency curve ogives)	1
4	Measures of dispersion of ungrouped and grouped data (Range, Quartile Deviation, Mean Deviation, Standard Deviation/Variance, Coefficient of variation)	1
5	Moments for grouped and ungrouped data; Measures of skewness and kurtosis	1
6	Simple problems on probability and probability distributions (using the definition of probability- Addition and Multiplication theorems)	1
7	Conditional probability- Binomial, Poisson and Normal distribution	1
8	Computation of correlation coefficient for bivariate frequency distribution and regression equations of y on x and x on y	1

9	Tests of significance of means in large samples (Z-test: one sample and two sample mean test) and in small samples [t-test one sample, two samples and two related samples mean test (paired t test)]	1
10	F-test testing of equality of two population variances	1
11	χ^2 - test: Test of independence and test of goodness of fit	1
12	Analysis of variance - CRD, RCBD, and Latin Square	1
13	Factorial experiment for 2 and 3 factors (Split and strip plot designs)	1
14	Use of Microsoft Excel for calculation of statistical data	1
15	Use of SPSS for the estimation of social science data and MSAT-C/ Mini-Tab/ Gen-Stat/ R-studio for the estimation of ANOVA	1
	Total	15

Recommended Reading Materials

1. Agrawal, B. L. (1996). *Basic Statistics (3rd edition)*. New Age International Pvt. Ltd. New Delhi.
2. Chandel, S. R. S. (1984). *A Hand Book of Agricultural Statistics*. Achal Prakashan Mandir, Kanpur, India.
3. Gupta, S. C. and Kapoor, V. K. (1988). *Fundamentals of Applied Statistics*. Chand and Com. New Delhi.
4. Kalicharan, N. (2001). *An Introduction to Computer Studies*. Cambridge University Press.
5. Singh, S. and Verma, R. P. S. (1982). *Agricultural statistics*. Rama Publishers, Meerut, India.

Course Code	ECD721
Course Title	Environmental Science, Climate Change and Disaster Management
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Students will learn about various aspects of environmental studies, ecosystem approach, climate change and disaster management.
Course Description
Introduction to environmental science and environmental studies; Various environmental issues; EIA and IEE; Climate change; Natural resource management and agriculture; Disasters and its management; Policies and institutional mechanisms.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction to Environmental Science and Environmental Studies	
1.1	Introduction to environmental science and environmental studies, objectives, importance and scope of environmental studies	1
1.2	Ethical worldviews, human and environment interaction	1
2	Ecosystem Principles Processes	
2.1	Ecosystem; Ecology and divisions of ecology; Energy flow in an ecosystem; Strength of natural ecosystem	1
2.2	Aspect of ecosystem; Comparison between natural and regulated ecosystem	1
2.3	Introduction to home garden, its principles, suitability in Nepalese context; Interactions and interrelationship of various components in home garden	1
3	Various Environmental Issues	
3.1	Environmental issues and types of environmental hazards	1
3.2	Land fragmentation in agriculture, ecological footprint and genetic pollution	1
3.3	Soil erosion, landslides, invasive species and urbanization	1
3.4	Issues of solid wastes management in Nepal	1
2.5	Pesticide misuse, impact of long term use of agrochemicals	1
4	EIA and IEE	
4.1	Introduction to Environmental Impact Assessment (EIA); Emergence of EIA; History of EIA in Nepal	1
4.2	Definition and types of EIA; Project Types, impacts and their types and the EIA processes and Project cycle	1
4.3	Screening and Initial Environmental Examination (IEE): Objectives of screening, screening procedure; Initial environmental examination and methods for IEE	1

4.4	Principles and steps of EIA; Comparison between IEE and EIA	1
4.5	Methods of impact identification of agricultural intensification; Environmental Audit	1
5	Climate Change and Climatic Variability	
5.1	Introduction to climate change and climatic variability, greenhouse effect, global warming and global dimming; Evidences of climate change; Vulnerability of women to climate change	1
5.2	Causes of climate change; uncertainty about climate change and weather forecasting	1
5.3	Three tier relationship of climate change and agriculture	1
5.4	Adaptation, mitigation and local innovation strategies to combat climate change; Nepal initiatives to limit climate change impacts	1
5.5	Climate Smart Agriculture: objectives, dimensions and applicability; Needs and opportunities of climate smart village approach	1
6	Natural Resource Management and Agriculture	
6.1	Introduction, concepts, principles and importance of natural resource management	1
6.2	Protected areas of Nepal	1
6.3	Integrated natural resource management in agriculture	1
6.4	Concept, principles and steps of community based biodiversity management	1
6.5	Conservation of traditional knowledge, value addition and economic incentives for ecological farming	
7.	Natural Disasters	
7.1	Meaning and nature of natural disasters, their types and effects; Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions; Heat and cold waves; Climate change: global warming, sea level rise, ozone depletion.	1
7.2	Disaster management- Concept of disaster management, national disaster management framework; Financial arrangements; Role of I/NGOs/ Community based organizations and media in disaster management	1
7.3	Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.	1
8	Policies and Institutional Mechanisms	
8.1	CBD and its implication in agriculture; Nagoya protocol; Farmers right; Environmental laws, Convention and Treaties and ITPGRFA	1
8.2	Various acts, policies and institutional mechanisms for combating climate change in Nepal	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Data collection and report preparation on linkages of farmers with agro-ecosystem and records of agro-biodiversity components	1
2	Documentation of agro-biodiversity present at around campus vicinity	1
3	Determine the minimum size of quadrat by species area curve method	1

4	Measurement of density, frequency, abundance and importance value index from species data	1
5	Calculation of effective number of species, evenness and Simpson index	1
6	Study of wetland flora and fauna near to the campus vicinity	1
7	Visit to any one : waste water treatment or landfill site or waste management practices at local level like municipality and report preparation	1
8	Document the awareness about pesticides and pesticides handling measures at a locality	1
9	Determination of dissolved oxygen in water by Winkler's method	1
10	Determination of dissolved carbon dioxide and dissolved solids	1
11	Seed collection and catalogue preparation of local and improved crop varieties	1
12	Preparation of statement of environmental impacts of local industries	1
13	Study of on-farm conservation strategies adopted by farmers near to campus vicinity	1
14	Visit to any protected areas of Nepal and report writing	1
15	Study and analyze the trend of global warming from multi-year temperature data till last year using NASA – Power and other data sources	1
	Total	15

Recommended Reading Materials

1. Altieri, M. A. (1987). *Agro ecology: the scientific basis of alternative agriculture*. Division of Biological Control. University of California, US.
2. Dessler, A. (2015). *Introduction to Modern Climate Change (2nd edition)*. Texas A & M University, US.
3. Khadka, R. B., Bisset, R. and Peter, A. (1986). *EIA Training Manual for Professionals and Managers*. IUCN.
4. Odum, E. P. (1996). *Fundamentals of Ecology*. Saunders Company, USA.
5. Sharma, P. D. (1992). *Ecology and Environment*. Rastogi Publication, Meerut, India.
6. Sthapit, B., Shrestha, P. and padhyay, M. (2012). *On-farm Management of Agricultural Biodiversity in Nepal*. Bioversity International.
7. Tivy, J. (1990). *Agricultural Ecology*. Longman Group Ltd., Essex, UK.

Horticulture and Agro-Forestry

Horticulture

Course Code	HRT121
Course Title	Fundamentals of Horticulture
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
The students will be acquainted with the basic concept, principles and practices related to horticultural crop production.
Course Description
Meaning, branches and relation of horticulture with other disciplines; Classification of horticultural crops, status and potential of horticulture development in Nepal; Factors affecting horticulture crop production and measures to overcome them, Introduction to various types of horticultural enterprises, orchard establishment and management; Basics of plant propagation and various methods; Growth and development of horticultural plants; Major classes of plant growth regulator and their commercial use in horticulture; Basic principles and methods of training and pruning; Basic principles of off- season and protected horticulture; Organic horticulture crop production in Nepal; Concept of high density planting, multi- storied cropping, multiple cropping and agro forestry with horticultural crops; Indigenous horticultural crops in Nepal; Principle of urban and peri-urban horticulture; Vermi composting, soil less culture and riverbed horticulture.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	1
1.1	Meaning of horticulture, its branches and relation with other disciplines	
1.2	Importance, scope and present status of horticulture in Nepal along with major constraints in its development	1
1.3	Classification of horticultural crops	1
1.4	Horticultural zoning of Nepal and its economic significance	1
2	Environmental Factors Affecting Horticultural Crop Production	
2.1	Effect of temperature, light, humidity, rainfall, wind and their stress on production	1
2.2	Measures to overcome environmental stress	1
3	Enterprises in Horticulture	
3.1	General introduction to types of horticultural enterprises (Orcharding, nursery raising, ornamental gardening, landscape, vegetable farming, seed production and post-harvest handling and preservation)	1
4	Orchard Establishment and Management	
4.1	Site selection and layout of orchard	1

4.2	Planting, soil and water management practices, wind break and shelter belts	1
4.3	Fertility and weed management	1
5	Basics of Plant Propagation	
5.1	Introduction of plant propagation, sexual method	1
5.2	Asexual methods	1
5.3	Cutting and layering	1
5.4	Budding and grafting	1
8.5	Apomixis, specialized vegetative parts, micro and mist propagation	1
6	Growth and Development in Horticulture Crop	
6.1	Concept of growth and development, dormancy (seed and bud)	1
6.2	Germination, juvenility and maturity	1
6.3	Flowering, fruitset, fruit growth and development	1
6.4	Fruit maturity and ripening, unfruitfulness, fruit drop	1
6.5	Tuber, rhizome and bulb development, senescence	1
7	Plant Growth Regulators	
7.1	Types of plant growth substances (auxin, gibberellins, cytokinins, ethylene and inhibitors), and their major functions	1
7.2	Commercial uses of PGRs in Horticulture	1
8	Training and Pruning	
8.1	Basic principles and objectives of training and pruning	1
8.2	Various system/ methods of training and pruning	1
9	Basic principles of off season and protected horticulture and their prospects and constraints in Nepal	1
10	Importance and prospects of organic horticultural crop production in Nepal	1
11	Concept of high density planting, multi-tier cropping, multiple cropping and agro forestry	1
12	Importance and prospects of indigenous horticultural plants in Nepal	1
13	Principles of urban and peri-urban horticulture; Vermiculture, hydroponics and aeroponics, and river bed farming	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Mapping of Nepal in terms of agro-climatic zones and potential regions for growing major horticultural crops	1
2	Identification of fruit, vegetable, plantation, medicinal, spices and ornamental plants	1
3	Identification of horticultural tools and equipments; manures and fertilizers; hormones and micronutrients	1
4	Orchard layout for different system of fruit planting	1
5	Preparation of pit for planting fruit saplings	1
6	Preparation of nursery bed for sowing of vegetable seed	1
7	Propagation practice in horticultural plants	

7.1	Cutting	1
7.2	Layering	1
7.3	Grafting	1
7.4	Budding	1
8	Training practice in horticultural plants	1
9	Pruning practice in different horticultural plants	1
10	Preparation and application of Bordeaux formulation	1
11	Preparation of hot bed for germination of vegetable seed in winter	1
12	Preparation of different concentrations of PGR for horticultural uses	1
	Total	15

Recommended Reading Materials

1. Chattopadhyay, T.K. (2001). *A Text Book on Pomology. Vol I.* Kalyani Pulishers, India.
2. Prasad, S. and U. Kumar. (2017). *Principles of Horticulture, 2nd edition.* Agrobios, Jodhpur, India.
3. Shrestha, G.K., Shakya, S.M., Baral, D. R. and Gautam, D. M. (2001). *Fundamentals of Horticulture (2nd Edition).* Inst. Agri. and An. Sci, Rampur, Chitwan, Nepal.
4. Shrestha, G.K., Shakya, S.M., Baral, D. R. and Gautam, D. M. (1993). *Laboratory Manual on Fundamentals of Horticulture.* IAAS, Rampur.

Course Code	HRT211
Course Title	Ornamental Horticulture
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to understand ornamental horticulture and gain basic knowledge and skills on landscape gardening and production system of cut flowers and ornamentals.

Course Description

Definition, history and importance of Ornamental Horticulture, current status of ornamental horticulture industry in Nepal; Classification of ornamental plants, definition, history, scope, features and components of landscape gardening; Elements and principles of landscape gardening design, use of plants in landscape design; Lawn and its management; Flower arrangement and bonsai; Establishment of nursery enterprise and propagation of ornamentals, commercial cultivation of important cut flowers and loose flowers.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction	
1.1	Importance and history of Ornamental Horticulture.	1
	Definition, historical importance of ornamental horticulture	

	Floriculture industry in Nepal, its status, prospects and constraints	
2	Classification of Ornamental Plants	
2.1	Classification of ornamental plants based on their aesthetic and functional values: Flowering plants, ornamental foliage trees, shrub and shrubberies, climbers, cactus and succulents, bulbous plants; and based on their life cycle:- Annual, biennial and perennial	1
3	Ornamental Gardens and Landscaping	
3.1	Landscape gardening: Definition, history, scope, features and components of landscape gardening	1
3.2	Elements and principles of landscape gardening; Types of landscape gardening design; Use of plants in landscape design	1
4	Lawn Garden	
4.1	Lawn and its preparation; Selection of grasses in different ecological zones, planting and sowing of seeds; Management of lawn grasses	1
5	Flower Design	
5.1	Flower arrangements: Importance, styles (design), materials used in flower arrangements; Eastern and western type of flower arrangements	1
6	Bonsai	
6.1	Introduction and history of bonsai making, selection of plants, style and management of bonsai	
7	Nursery Management	
7.1	Establishment of nursery enterprises; Planning of a nursery enterprises; Nursery media, pot type or containers; Equipment, propagation and structures	1
8	Cultivation Practices of Ornamental Crops Introduction, area, production and distribution, soil and climatic requirements, land preparation, improved varieties, cultural practices, propagation, planting materials, planting time, planting methods, manures and fertilizers, irrigation and drainage, weed management, harvest and post-harvest practices, disorders, diseases and insect pest of the following crops	
8.1	Gladiolus	1
8.2	Rose	1
8.3	Tuberose	1
8.4	Orchids	1
8.5	Carnation and Gerbera	1
8.6	Chrysanthemum	1
8.7	Marigold, Gomphrena and Protea	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification and herbarium collection of ornamentals	1
2	Visit to nursery enterprises, private and public gardens	2
3	Practices in landscape gardening design	1

4	Preparation of flower bed/seed bed/nursery bed	1
5	Media preparation, potting and repotting of ornamental plants	1
6	Designing, development and maintenance of lawn	1
7	Bonsai styling and making	1
8	Arranging flowers for different occasion	1
9	Cultivation of seasonal cut flowers and foliage	2
10	Interior capping and maintenance of indoor plants	1
11	Training and pruning practice of ornamental plants	1
12	Propagation practices in different types of ornamental plants	1
13	Harvesting and post-harvest care of cut and loose flowers	1
14	Total	15

Recommended Reading Materials

1. Anonymous. (2000). *Better Homes and Gardens: The Complete Backyard Book*. Murdoch Books
2. Arora, J.S. (1990). *Introductory Ornamental Horticulture*. Kalyani Publisher, New Delhi.
3. Bose, T.K. and Yadav, L. P. (1989). *Commercial Floriculture*. Naya Prakash, Calcutta.
4. Dirr, M. (2002). *Dirr's Trees and Shrubs for Warmer Climate*. Timber Press
5. Dirr, M. (2009). *Manual of Woody Landscape Plants (6th edition)*. Stipes Publishing
6. Lauria, A. and Victor, H.R. (2001). *Floriculture: Fundamentals and Practices*. Agrobios, India.
7. Mchoy, P., Segall, B. and Donaldson, S. (1997). *Practical Small Gardening*. Acropolis Books.
8. Randhawa, G.S. and Mukhopadhyay, A. (1986). *Floriculture in India*. Allied Publisher, India.
9. Tony, A. (2003). *So you want to start a nursery*. Timber Press.

Objective (s) of the Course	
Course Code	HRT321
Course Title	Vegetable and Spice Crop Production
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25
This course has been designed for B. Sc. Ag degree students to make them able to know the basic knowledge and skills on the principles and practices of vegetable and spice crop production in Nepal.	
Course Description	
Present status, importance, prospects and constraints of vegetable and spice crop production in Nepal; Basic principles of vegetable and spice crop production: classification of vegetable and spice crops, climatic and soils factors affecting production and quality, off-season and protected cultivation, riverbed and rainfed farming and nursery management; Description of major vegetable and spice crops on the headings: origin, distribution, area and production in Nepal, climate and soil, important varieties, field preparation, application of manures and fertilizers, intercultural practices, irrigation and drainage, plant protection measures, disorders, off-season	

and protected production, harvesting and post-harvest handling and brief introduction of minor vegetable crops.

Course breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	
1.1	Present status, importance, prospects and constraints of vegetable and spice crops production in Nepal.	1
2	Basic Principles of Vegetable and Spice Crop Production	
2.1	Classification of vegetable and spice crops	1
2.2	Climatic and soils factors affecting vegetable and spice crop production and quality	1
2.3	Off-season and protected cultivation of vegetable and spice crops	1
2.4	Nursery management	1
2.5	Appropriate cultivation practices under river bed and rain-fed condition	1
3	Production Technologies of the major Vegetable and Spice crops which include: Origin, distribution, area and production in Nepal, climate and soil, improved varieties, field preparation, application of manures and fertilizers, intercropping practices, irrigation and drainage, plant protection measures, disorders, off-season and protected production, seed production, harvesting and post harvesting handling	
3.1	Production Technology of Solanaceae Vegetables	
3.1.1	Tomato	1
3.1.2	Potato	1
3.1.3	Brinjal	1
3.1.4	Chilli and sweet pepper	1
3.2	Production Technology of Cruciferae /Brassicaceae Vegetables	
3.2.1	Cauliflower	1
3.2.2	Cabbage	1
3.2.3	Broccoli and Knolkhol	1
3.2.4	Radish and turnip	1
3.2.5	Rayo and Cress	1
3.3	Production Technology of Cucurbitaceae Vegetables	
3.3.1	Cucumber	1
3.3.2	Watermelon, pumpkin and summer squash	1
3.3.3	Bottle gourd and bitter gourd	1
3.3.4	Sponge gourd and pointed gourd	1
3.4	Production Technology of Fabaceae/Leguminosae Vegetables	
3.4.1	Peas, French bean and cow pea	1
3.4.2	Fenugreek	1
3.5	Production Technology of Umbelliferae/Apiaceae Vegetables	
3.5.1	Carrot, coriander and cumin	1
3.6	Production Technology of Zingiberaceae Vegetables	

3.6.1	Ginger and turmeric	1
3.7	Production Technology of Alliaceae vegetables	
3.7.1	Onion and garlic	1
3.8	Production technology of Chenopodiaceae vegetables	
3.8.1	Spinach and swiss chard	1
3.9	Liliaceae and Convolvulaceae vegetables: Asparagus and sweet potato	1
3.10	Malvaceae vegetables: Okra	1
3.11	Brief introduction to the following minor crops	1
3.11.1	Ridge gourd, snake gourd, chayote, muskmelon, broad bean, tree tomato and drumstick	1
3.11.2	Colocasia, Yam, cassava, garden beet, amaranth, Brussel's sprouts, lettuce, celery, parsnip, dill and fennel	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of seasonal vegetable and spice crop plants and study the morphology of their edible parts	1
2	Identification of vegetable and spice crop seeds and prepare their catalogue	1
3	Layout of kitchen garden and selection of vegetable and spice crops for cultivation	1
4	Nursery bed preparation and sowing seeds of vegetable crops	1
5	Growing seedlings of cucurbitaceous crops under plastic tunnel in winter	1
6	Computation of basal doses of manure and chemical fertilizers and their application	1
7	Calculation of seedlings requirement and their transplanting	1
8	Intercultural practices (earthing up, mulching, irrigation and others)	1
9	Application of side dresses and micronutrients	1
10	Practices of staking, training and pruning	1
11	Preparation and application of pesticides	1
12	PGRs and their application in vegetable crops	1
13	Harvesting and post-harvest handling of vegetable and spice crops	1
14	Display and judging of fresh vegetable crops	1
15	Visit to the commercial vegetable farm near to the FWU campus	1
	Total	15

Recommended Reading Materials

1. ICAR. (2001). *Text Book of Vegetables, Tuber Crops and Spices*. (Ed. S. Thamburaj and Narendra Singh), Indian Council of Agricultural Research, New Delhi, India.
2. Bose, T.K., Som, M. G and Kabir, J. (1993). *Vegetable Crops*. Naya Prakash, Calcutta.
3. Pun, L. and Karmacharya, B.B. (1988). *Trainer's Manual — Vegetables*. Department of Agric, Agric. Manpower Development and Training Program, Kathmandu.

4. Shakya, S.M., Thapa, F. and Pant, J. (1991). *Laboratory Manual on Vegetable Production and Ornamental Horticulture*. IAAS, Rampur, Chitwan.
5. Shanmugavelu, K. G. (1989). *Production Technology of Vegetable Crops*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Singh, S.P. (1989). *Production Technology of Vegetable crops*. Universal Pub. Centre, Karnal, India.
7. Singh, S.P. (1997). *Principles of Vegetable Production*. Agrotech Pub. Academy, Udaipur.

Course Code	HRT521
Course Title	Fruit and Plantation Crop Production
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
The students will get knowledge regarding the potential fruit and plantation crop growing areas in Nepal for commercial production and will understand and gain skills about the physiology, growth behavior, nutrient, cultural requirements and management of important fruit and plantation crops.
Course Description
Scope and importance of fruit and plantation crop production in Nepal; Classification of fruits based on climate requirement, pomological classification and growth habit etc; Identification of potential pocket area for commercial production of fruit and plantation crops; Origin, botany, uses, distribution/ area/ production, climate, soil, cultivar, planting, propagation, training and pruning, growth behavior, flowering, fruit set, fruit drop, nutrition, manure and fertilizers, irrigation, intercropping, use of bio-regulators, disease and pest, specific problem, physiological problems, harvesting, storage and marketing of banana, mango, papaya, pineapple, jackfruit, litchi, guava, citrus, pomegranate, apple, pear, peach, plum, walnut, apricot, kiwi, strawberry, grape, tea, coffee, cardamom and other indigenous and under-exploited fruit crops.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	
1.1	Scope, importance and constraints of fruits and plantation crops in Nepal	1
1.2	History and government policy of fruit and plantation sector development in Nepal	1
1.3	Major potential pocket areas for commercial production of fruit and plantation crops	1
2	Cultivation Practices of Tropical and Sub-tropical Fruits: Introduction, origin, distribution, area and production in Nepal, climate and soil, improved varieties, field preparation, application of manures and fertilizers, intercultural practices, irrigation and drainage, plant propagation, plant protection measures, disorders, off-season and protected production, seed	

	production, harvesting and post harvesting handling	
2.1	Banana	2
2.2	Mango	2
2.3	Papaya	1
2.4	Pineapple	1
2.5	Jack fruit	1
2.6	Litchi	1
2.7	Guava	1
2.8	Citrus	2
3	Cultivation Practices of Temperate Fruits: Introduction, origin, distribution, area and production in Nepal, climate and soil, improved varieties, field preparation, application of manures and fertilizers, intercultural practices, irrigation and drainage, plant propagation, Plant protection measures, disorders, off-season and protected production, seed production, harvesting and post harvesting handling	
3.1	Apple	1
3.2	Pear	1
3.3	Peach	1
3.4	Pulms and nectarines	1
3.5	Walnut	1
3.6	Kiwi	1
3.7	Grapes	1
4	Cultivation Practices of Indigenous and Under-exploited Crops	
4.1	Aonla, Persimmon and Macademia	1
4.2	Custard apple, wood apple and bael	1
4.3	Avocado and apricot	1
4.4	Ber, lapsi and passion fruit	1
4.5	Dragon fruit and olive	1
5	Cultivation practices of tea	1
6	Cultivation practices coffee	2
7	Cultivation practices cardamom	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of tools, equipment and chemicals used in the production of fruit and plantation crops	1
2	Field visit, identification of species and varieties of fruit and plantation crops	1
3	Layout and planning of orchard	1
4	Digging and filling back of pits	1
5	Practices of cutting and layering	1
6	Practices of grafting and budding	1
7	Processing of coffee / tea/ cardamom	1
8	Detachment of layered/ grafted plant, preparation of seedling/sapling and	1

	transplanting	
9	Training of fruit and plantation crops	1
10	Pruning of fruit and plantation crops	1
11	Fertilizer application and irrigation practices	1
12	Calculation, preparation and application of stock solution of plant growth regulators and micronutrients	1
13	Sampling technique for soil and plant parts for nutrient analysis	1
14	Visit to tropical/subtropical/temperate horticultural farm	1
15	Preparation of project for establishing enterprises on fruit /plantation crop/orchard	1
	Total	15

Recommended Reading Materials

1. Chattopadhyay, T.K. (2001). *A Text Book on Pomology. Vol I, II, III and IV*. Kalyani Publishers, India.
2. Kumar, N., Abdul, K., Rangaswami, P. and Irulappan, I. (2000). *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants*. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi, India.
3. Ponnuswami, V., Kumar, M., Ramesh Kumar, S. and Krishnamoorthy, C. (2015). *Text Book on Fruit and Plantation Crops*. Narendra Publishing House.
4. Shrestha, G. K. (2016). *Fruits and Plantation Crops: Basic Principles, Production Techniques and Practical Skills*. Heritage Publishers and Distributors Pvt. Ltd., Nepal.

Course Code	HRT611
Course Title	Protected Horticulture
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will have the skill and recent technical and scientific knowledge to successfully grow the protected crop production system in Nepal.

Course Description

Protected cultivation; Status of protected cultivation; Types of Green Houses; Plant response to Greenhouse environment; Planning and design of greenhouses; Design criteria of green house for cooling and heating purposes; Greenhouse equipment, materials of construction for traditional and low cost greenhouses; Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air greenhouse heating systems; Greenhouse cultivation of important horticultural crops; Cultivation of economically important medicinal and aromatic plants; Off-season production of flowers and vegetables; Insect pest and disease management.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction	

1.1	Protected cultivation: importance and scope	1
1.2	Status of protected cultivation in Nepal and world types of protected structure based on site and climate	1
1.3	Types of Green Houses; Plant response to Greenhouse environment	1
1.4	Planning and design of greenhouses; Design criteria of green house for cooling and heating purposes	1
1.5	Green house equipment, materials of construction for traditional and low cost green houses	1
1.6	Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air greenhouse heating systems.	1
2	Greenhouse Cultivation of Important Flower Crops	
2.1	Rose	1
2.2	Gerbera	1
2.3	Carnation	1
2.4	Chrysanthemum	1
3	Greenhouse Cultivation of Important Vegetables	
3.1	Tomato	1
3.2	Cucumber	1
3.3	Strawberry	1
4	Cultivation of economically important medicinal and aromatic plants	
4.1	Aloe, datura and mint	1
4.2	Citronella and lemon grass	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study of different type of greenhouses based on shape	2
2	Raising of seedlings and saplings under protected conditions	2
3	Use of portrays in quality planting material production	2
4	Bed preparation and planting of crop for production	2
5	Intercultural operations	3
6	Soil EC and pH measurement	2
7	Determination of drying rate of agricultural products inside greenhouse	1
8	Visit to various post-harvest Laboratories	1
	Total	15

Recommended Reading Materials

1. Hanan, J. J. (1997). *Greenhouses: Advanced Technology for Protected Horticulture*. CRC Press Reference: ISBN 9780849316982.
2. Ernst, V. H. and Van Der Post, K. (2004). *Protected Cultivation: Construction Requirements and Use of Greenhouse in Various Climates*. Agromisa Foundation, Wageningen, Netherlands.
3. Bose, T. K. and Yadav, L. P. (1989). *Commercial Floriculture*. Naya Prakash, Calcutta, India.

Course Code	HRT721
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Course Title	Post-Harvest Horticulture
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course the students will get basic knowledge and skills on post-harvest physiology, handling, processing and preservation and storage of the fresh horticultural produces.
Course Description
Importance and scope of postharvest horticulture; Postharvest physiology of fruits, vegetables and cut flowers; Maturity judgment and maturity indices; Causes of deterioration; Transpiration, respiration, ethylene production, physiological disorders, post-harvest insect pest and post-harvest diseases; Packaging and packing house operations; Sorting, grading, curing, waxing, trimming, de-handing, chemical treatment, sugar pulsing, pre-cooling, fumigation and packaging; Storage of fruit and vegetables, factors affecting storage, different methods of storage; Marketing and markets for fruit, vegetables and cut flowers; Principles and methods of preserving fruit, vegetables and ornamental; Quality control and assessment, organoleptic evaluation; Handling of specific fruits, vegetables and cut flowers; Principles and methods of processing and preservation

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	
1.1	History and importance of post-harvest horticulture	1
2	Post-harvest Physiology	
2.1	Post-harvest physiology of fruits, vegetables and ornamentals	1
2.2	Transpiration: Factors affecting transpiration and effects of transpiration on post-harvest	1
2.3	Respiration: Aerobic and anaerobic respiration, Electron transport system	1
2.4	Effects of respiration on post-harvest	1
2.5	Ripening: Physiological changes during ripening control of ripening	1
2.6	Ethylene: Mode and mechanism of ethylene action, biosynthesis of ethylene, post-harvest use of ethylene	1
3	Maturity Determination	
3.1	Physiological maturity methods for maturity judgment, method and time of harvesting	1
3.2	Commercial maturity for maturity judgment, method and time of harvesting	1
4	Factors Responsible for Deterioration of Horticultural Produce	1
5	Protection Measures of Post-harvest Products	

5.1	Post-harvest diseases	1
5.2	Control measures of post-harvest diseases	1
5.3	Physiological disorder of post-harvest	1
5.4	Preventive measures of post-harvest physiological disorder	1
5.5	Post-harvest insect pest	1
5.6	Control measure of post-harvest insect pest	1
6	Packing House Operation	
6.1	Sorting, grading, sizing, cleaning and curing	1
6.2	Trimming, de-handling, waxing, chemical treatments and packaging	1
7	Packaging	
7.1	Design of packaging material and consideration in packaging.	1
8	Curing	
8.1	Principle and methods of curing	1
9	Storage	
9.1	Principles of storage	1
9.2	Factor affecting storage	1
9.3	Methods of storage	1
10	Post-harvest Quality	
10.1	Criteria of post-harvest quality	1
10.2	Judgement of post-harvest quality	1
11	Market	
11.1	Markets of horticultural produces	1
11.2	Marketing of horticultural produces	1
12	Preservations	
12.1	Principles of preservations	1
12.2	Methods of preservations	1
13	Commodity profile of major fruits, vegetables and cut flowers	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of equipment, tools and chemicals used in post-harvest horticulture	1
2	Determination of Total Soluble Solids (TSS) and titratable acidity (TA)	1
3	Determination of physiological loss in weight (PLW) and spoilage loss	1
4	Artificial ripening of banana	1
5	Drying of vegetables	1
6	Preparation of potato chips	1
7	Preparation of tomato ketchup	1
8	Preparation of squash	1
9	Preparation of Jam	1
10	Preparation of pickles	1
11	Preparation of jelly and marmalade	1
12	Visit to markets, collection center packaging house and cold storage	1
13	Maturity judgment and harvesting of fruits/ vegetables/ ornamental crops	2
14	Organoleptic evaluation and hedonic rating	1
	Total	15

Recommended Reading Materials

1. Kader, A. A. (2002). *Post-harvest Technology of Horticultural Crops*. Post-harvest Technology Center, UC DAVIS Department of Plant Sciences.
2. Bautista, O.K. (1990). *Post-harvest Technology for Southeast Asian Perishable Crops*. University of the Philippines, Technology and Livelihood Resource Center, Philippines.
3. Gautam, D.M. and Bhattarai, D. R. (2012). *Post-harvest Horticulture*. Pabitra and Shanta. Bhawani Printers Chabahil Kathmandu, Nepal.
4. Sudheer, K. P. and Indira, V. (2007). *Post-Harvest Technology of Horticultural Crops*. New India Publishing.
5. Kays, S.J. (1998). *Post-harvest Physiology of Perishable Plant Products*. CBS Publisher and Distributors, New Delhi, India.

Agro-Forestry

Course Code	AGF111
Course Title	Fundamentals of Agro-forestry
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the student will have basic knowledge on principles and practices of agro-forestry systems.
Course Description
Concept of agro-forestry; Definition, importance and scope; Roles of trees in fulfilling the basic requirements of people; Characteristics of trees for agro-forestry development and tree

improvement; Agro Forestry System (AFS); Classification of the agro forestry system and overview of AFS in Nepal and similar agro-eco-zoning in the world; Tree-crop-interaction, nature of interaction, factors, types, quantifying interactions; Soil management under AFS; Conceptual framework for designing AFS; Project development; ICFAF'S diagnosis and design, diagnostic methods and tools used in AFS; Management of tree in AFS; Tree management, agricultural management, silvi-cultural and management operations; Quantifying agro-forestry products.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Concept of Agroforestry: Definition, importance and scope	1
2	Tree Selection and Improvements	
2.1	Role of trees in fulfilling the basic requirements of people	1
2.2	Characteristic of tree for agroforestry development and tree improvement	1
3	Agroforestry System (AFS)	
3.1	Classification and over-view of Agroforestry System (AFS)	1
3.2	Agroforestry system in Nepal and similar agro-eco-zoning in the world	1
4	Nature of Tree-crop Interaction	
4.1	Factors and types on nature of tree- crop interaction	1
4.2	Quantifying the agro-forestry product	1
5	Soil management under Agroforestry System	
5.1	Approaches of soil-water conservation	1
5.2	Soil fertility management under Agroforestry system	1
6	Designing Agroforestry System	
6.1	Conceptual framework for designing AFS	1
6.2	Factors affecting Agroforestry system	1
7	Project Development in Agro-forestry	
7.1	ICFAF's diagnosis and design	1
7.2	Diagnostic methods and tools used in AFS	1
8	Management of Trees in AFS	
8.1	Management of tree in Agriculture	1
8.2	Agricultural and silvi-cultural management in relation to crop	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Tree selection and identification for AFS at different area	
1.1	High hills	1
1.2	Mid Hills	1
1.3	Terai	1
2	Practice in contour farming system	1
3	Preparation 'A'-frames and determines contour lines	1
4	Layout of soil-water conservation systems	1
5	Nursery establishment for AFS	
5.1	Collection and identification of seeds of Agro-forestry trees	1
5.2	Preparation of nursery bed for agro- forestry trees	1
5.3	Seed sowing of agro-forestry trees	1
6	Tree-clinic for AFS	1
7	Training and pruning for Agro-forestry trees	1
8	Height and canopy measurement for selected agro-forestry trees	1
9	Different AFS development (SALT and Home garden)	1
10	Design and Establishment of agroforestry farm at Far Western University (FWU)	1
11	A visit to success story of agro-forestry projects at local level	1
	Total	15

Recommended Reading Materials

1. Chaundawat, B.S. and Gautam, S. K. (1996). *Text of Agro-forestry*. Oxford and IBM Publishing Co. Pvt. Ltd.India.
2. Dwivedi, A.P. (1992). *Agro-forestry: Principles and Practices*. Oxford and IBM Publishing Co. Pvt. Ltd.India.
3. Prakash, Ram. (1991). *Propagation Practices of important Indian Trees*. International Book Distributions, India.
4. Singh, S.P. (1998). *Handbook of Agro-forestry*. Agrotech Publishing Academy, India.
5. Thapa, F. (2001). *Nepalese Flora for Agro-forestry Systems*. S.B. Bhandari Publication, Nepal.

Course Code	AGF411
Course Title	Medicinal and Aromatic Plants
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to understand the importance of Medicinal and Aromatic Plants (MAPs), its traditional uses and research status of MAPs.

Course Description

Introduction, history, classification, importance, prospects and constraints of MAPs; Research status of MAPs in Nepal; Extraction and storage methods for MAPs; Impacts of environmental degradation; Climate change and over exploitation of MAPs, Phyto-medicine and uses of MAPs in different traditional health care system and description; Origin, distribution and chemical evaluation of Medicinal and Aromatic Plants.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction, history and classification of Medicinal and Aromatic Plants	1
2	Importance, prospects and constraints of Medicinal and Aromatic Plants	1
3	Classification of Medicinal and Aromatic Plants	1
4	Extraction and storage methods for Medicinal Plants	1
5	Status of environmental degradation and climate change in Nepal	1
6	Effects of climate change and environmental degradation in MAPs	1
7	Ways to reduce effect of climate change and over exploitation of MAPs	1
8	Phyto-medicines and Medicinal crops; Uses of Medicinal Plants in Aurveda	1
9	Uses of Medicinal Plants in Siddha, Yoga, Unani, Naturopathy, Homeopathy, Chinese Medicine	1
10	Uses of Medicinal plants in Folk-remedies and other traditional health care system	2
11	Description, origin, distribution and chemical evaluation of common MAPs	
11.1	Medicinal Plants: Aloe, Datura	1
11.2	Medicinal Plants: Rauwolfia, Neem	1
11.3	Aromatic Plants: Ginger Grass, Mint	1
11.4	Aromatic Plants : Rose, Tulsi	1
	Total	15

Course Breakdown (Practical)

SN	Course Outline	Lectures
1	Preparation of questionnaire designed for recording traditional uses of locally available herbs/ MAPs	1

2	Pre-testing of questionnaire designed for recording traditional uses of locally available herbs/ MAPS	2
3	Documentation of local uses of important medicinal plants of local tribal community Tharu	1
4	Documentation of local uses of important medicinal plants of local tribal community Bote	1
5	Identification of important high value herbs and their products	1
6	Identification of important aromatic plants and their products	1
7	Nursery bed preparation of medicinal and aromatic plants	2
8	Planting of medicinal plants	1
9	Planting of aromatic plants	1
10	Field observation of herbal farms (medicinal plants)	1
11	Field observation of herbal farms (aromatic plants)	1
12	Field observation of processing plants (medicinal plants)	1
13	Field observation of processing plants (aromatic plants)	1
	Total	15

Recommended Reading Materials

1. Atal, C.K. and Kanpur, B.M. (1982). *Cultivation and Utilization of Medicinal and Aromatic Plants*. Regional Research Laboratory, CSIR, Jammu, Tawi, India.
2. Bhattacharjee, S.K. (2000). *Hand Book of Aromatic Plants*. Pointer Publisher, Jaipur, India.
3. Hussain, A. (1992). *A status report on Cultivation of Medicinal Plants in NAM countries*. Center of Science and Technology of the Non-aligned and other developing Countries, New Delhi.
4. IUCN. (2000). *National Register of Medicinal Plants*. IUCN - Nepal, Kathmandu.
5. Kaufman, P.B., Cseke, L.J., Warber, S., Duke, J.A. and Brielman, H.L. (1999). *Natural Products from Plants*. CRC Press, UAS. Journal of Medicinal and

Plant Protection Entomology

Course Code	ENT321
Course Title	Fundamentals of Entomology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to understand the fundamentals of entomology, and understand the biology of industrially important insects such as honeybee, silkworm and lac insects.
Course Description
Introduction; Benefits and harms of insects; External morphology – cuticle, head, thorax and abdomen; Internal anatomy – different systems; Metamorphosis and development; Classification and study of economically important orders and families of insects; Life cycle of beneficial insects such as honey bee, mulberry silkworm and lac insect.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	
1.1	Definition and origin, evolution and position of insects in the animal kingdom	1
1.2	Reasons for the dominance of insects over other animals	1
1.3	Beneficial and harmful aspects of insects	1
2	External Morphology	
2.1	Insect body regions- head, thorax and abdomen	1
2.2	Insect cuticle and external processes	1
2.3	Head: segmentation, structure and orientation	1
2.4	Mouth parts and their modifications	1
2.5	Insect antennae and their modifications	1
2.6	Photoreceptors: compound and simple eyes	1
2.7	Thorax: segmentation, structure, legs and their modifications	1
2.8	Wings, venation and their modifications	1
2.9	Abdomen: segmentation, structure and appendages	1
3	Internal Anatomy	
3.1	Digestive system and excretory system	1
3.2	Reproductive system	1
3.3	Circulatory system	1
3.4	Respiratory system	1

3.5	Nervous system	1
4	Insect Metamorphosis, Growth and Development	1
5	System of Insect Classification	1
6	Classification and Study of Economically Important Orders and Families	
6.1	Thysanura, Odonata and Ephemeroptera	1
6.2	Isoptera, Orthoptera and Blattodea	1
6.3	Neuroptera, Siphonaptera and Thysanoptera	1
6.4	Phasmatodea, Psocodea and Embioptera	1
6.5	Mantodea, Dermaptera and Plecoptera	1
6.6	Coleoptera, Lepidoptera and Diptera	1
6.7	Homoptera, Hemiptera and Hymenoptera	1
7	Beneficial Insects	
7.1	Honeybee: beneficial aspects and life cycle	1
7.2	Mulberry silkworm: beneficial aspects and life cycle	1
7.3	Lac insect: beneficial aspects and life cycle	1
8	Sprayers: their parts, calibration and calculation of pesticides	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study of a microscope	1
2	Collection and preservation of insects	1
3	External morphology of an insect	1
4	Insect mouth parts and their modifications	1
5	Insect antennae and their modifications	1
6	Insect legs and their modifications	1
7	Insect wings and their modifications	1
8	Insect dissection and study of internal anatomy of an insect (digestive, reproductive, nervous, circulatory and respiratory systems)	1
9	Insect metamorphosis	1
10	Types of larvae and pupae	1
11	Modern beehive and its parts	1
12	Life cycle of honeybee, silkworm and lac insect	1
13	Introduction and principles of insect rearing	1
14	Classification of insects (Important families of the orders: Thysanura, Odonata, Orthoptera, Blattodea, Hemiptera, Homoptera, Coleoptera, Diptera, Lepidoptera, Hymenoptera and other important orders of insects)	1
15	Sprayers and their calibration	1
	Total	15

Recommended Reading Materials

1. Chapman, R. F. (2013). *The insects: Structure and Function*, 5th Ed. Cambridge University Press, Cambridge, United Kingdom.
2. Dhaliwal, G.S. (2015). *Elements of Agricultural Entomology*. Kalyani Publishers, India.

3. Elzinga, R.T. (2003). *Fundamentals of Entomology*. Prentice Hall, New Jersey, USA.
4. Fenemore, P. G. and Prakash, A. (2006). *Applied Entomology*. New Age International, New Delhi.
5. Pedigo, L.P. and Rice, M.E. (2014). *Entomology and Pest Management*, 6th ed. Pearson Prentice Hall, New Jersey, USA.
6. Singh, R. (2016). *Elements of Entomology*. Rastogi Publications, Merrut, New Delhi.

Course Code	ENT421
Course Title	Principles and Practices of Insect Pest Management
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to understand the different principles and practices of insect pest management, and will be able to manage the insect pests independently.
Course Description
Pest management concepts; Elements of insect-pest management, insecticides, cultural, mechanical, physical and legislative measures of insect-pest management; Host plant resistance, attractants, repellents and genetic control; Parasitoids and predators; Use of insect pathogens; Pest management strategies for insects affecting man and domestic animals; and integrated insect pest management.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Agricultural Insect Pests and their Management	
1.1	Concept of crop pest, insect pest management, significance and historical aspect of insect pest management	1
1.2	Factors responsible for increasing insect pests in crop fields	1
2	Economics of Insect Pest Management	
2.1	Concept of threshold level and its importance in decision making	1
2.2	Tools for decision making: sampling and monitoring	1
2.3	Tools for decision making: survey and surveillance	1
3	Components of Insect Pest Management	
3.1	Cultural methods: principle, methods and significance	1
3.2	Mechanical method: principle, methods and significance	1
3.3	Physical method: principle, methods and significance	1
3.4	Biological method	
3.4.1	Concept and significance of biological pest management	1
3.4.2	Parasitoids and predators	1
3.4.3	Insect pathogens	1
3.4.4	Bio-control techniques in pest management	1

3.5	Chemical method	
3.5.1	History of insecticides and their significance in insect pest management	1
3.5.2	Types, classification and hazardous level of insecticides	1
3.5.3	Formulation of insecticides	1
3.5.4	Pollution caused by insecticide, insecticide poisoning, first aid and antidotes	1
3.5.5	Insecticide misuse and precautionary measures in Nepal	1
3.6	Legislative and quarantine method	
3.6.1	Basic concept of legislative approaches through quarantine	1
3.6.2	Quarantine of Nepal and their role in pest management	1
3.7	Host Plant Resistance (HPR)	
3.7.1	Basic concept, history and significance in pest management	1
3.7.2	Mechanisms and measurement techniques for HPR	1
3.7.3	Genetic engineering techniques and their significance in insect pest management	1
3.8	Insect behavior manipulation	
3.8.1	Basic concept and significance in pest management	1
3.8.2	Types of attractants and repellents	1
4	Integrated Pest Management (IPM)	
4.1	Concept of IPM, and its significance in pest management	1
4.2	Historical aspect of Integrated Pest Management (IPM) in world and in Nepal	1
4.2	Components and available tools of IPM in Nepal	1
4.3	Concept of IPM extension model: Farmers Field School (FFS)	1
5	Pesticide Residue Assessment Practices and Significance	1
6	Insect Pest Management in Precision Agriculture	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Field visit and interaction with farmers on insect pest problems	1
2	Identification and proper handling of pesticides in laboratory condition	1
3	Pesticide dilution and dose calculation for field application	1
4	Study on the use and handling of pesticide appliances	1
5	Scouting techniques to common insect pests at nearby farm	1
6	Identification and uses of microbial pesticides	1
7	Preparation of food bait for insect pest management	1
8	Preparation of poison bait and use for rodent control	1
9	Collection, preparation and use of botanical materials for insect pest management	1
10	Monitoring of insect pests by different traps (pheromone/pit fall/ sticky traps)	1
11	Monitoring of insect pests in light trap	1
12	Bio-assay techniques of pesticide and bio-pesticide against common pest	1
13	Pesticide survey in market and their classification: a case study	1

14	Insect zoo and cup study and its significance	1
15	Isolation of entomopathogenic fungi from soil and lab study of bio-pesticide focused on <i>Metarhizium</i>	1
	Total	15

Recommended Reading Materials

1. Dhaliwal, G. S. and Arora, R. (2003). *Principles of Insect-pest Management*. Kalyani Publishers, New Delhi, India.
2. Flint, M. L. (2012). *IPM in Practice: Principles and Methods of Integrated Pest Management*. University of California Agriculture and Natural Resources, USA.
3. Koul, O., Dhaliwal, G.S. and Cuperus, G.W. (2004). *Integrated Pest Management: Potential, Constraints and Challenges*. CABI.
4. Manandhar, D. N. (2006). *Pesticides in Nepal*. The Rising Sun Printers, Teku, Kathmandu.
5. Neupane, F. P. (2002). *Tarkari Balima Lagne Kiraharuko Ekikrit Byabasthapan (in Nepali version)*. Jagadamba Press, Lalitpur, Nepal.
6. Norris, R.F., Caswell-Chen, E.P. and Kogan, M. (2002). *Concepts in Integrated Pest Management*. Prentice Hall of India Pvt. Ltd., New Delhi, India.

Course Code	ENT521
Course Title	Insect Pests of Crops and their Management
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to know common insect pests of crops, their identification and management practices using bio-rational techniques.

Course Description

Systematic position, distribution, host identification, nature and extent of damage, life cycle, seasonal histories and control measures of important insect and non-insect pests of cereals and millets, pulses, oilseeds, vegetables, fruits, industrial crops, spices and condiments grown in Nepal; Important stored grain pests and their control; introduction and management of medical and veterinary, vector borne, polyphagous and soil hibernating insect pests.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Insect Pests of Cereal crops and their Management	
1.1	Insect pests of rice and their management (Yellow stem borer, brown plant hopper, rice grasshopper, seed bed beetle, rice ear-head bug, rice ear-cutting caterpillar, rice hispa, case worm, leaf folder and others)	1
1.2	Insect pests of maize and their management (Maize stem borer, fall armyworm, white grub, wireworm, flower beetle and	1

	others)	
1.3	Insect pests of wheat and millet and their management (Pink borer, armyworm, grasshopper, cutworm, termite, aphid and others)	1
2	Insect Pests of Pulse crops and their Management	
2.1	Insect pests of chickpea, beans, blackgram and green gram (Chickpea pod borer, pod fly, soybean hairy caterpillar, pea leaf miner, pea pod borer, sphinx moth, semilooper, legume pod bug and others)	1
2.2	Insect pests of lentil, pigeon pea and mung bean (Spotted pod borer, plume moth, pod weevil, blister beetle, whitefly, stem fly and others)	1
3	Insect Pests of Oilseed crops and their Management	
3.1	Insect pests of mustard, rapeseed, sesame and sunflower (Mustard aphid, painted bug, mustard sawfly, white grub and others)	1
3.2	Insect pests of groundnut and soybean (White grub, groundnut aphid, groundnut leaf miner, soybean hairy caterpillar, soybean pod borer and others)	1
4	Insect Pests of Vegetables and their Management	
4.1	Insect pests of crucifer crops (Cauliflower, cabbage and broccoli) (cabbage butterfly, diamond back moth, flea beetle, mustard sawfly, cabbage aphid, cutworms and others)	1
4.2	Insect pests of solanaceous crops (Potato, tomato, chilli and brinjal) (Tomato fruit borer, tomato leaf miner, whitefly, brinjal shoot and fruit borer, red ant, potato tuber moth, chilli thrips, brinjal leaf roller and others)	1
4.3	Insect pests of cucurbits (Cucumber, pumpkin, bitter gourd, bottle gourd, sponge gourd, pointed gourd, summer squash, chayote and melons) (Red pumpkin beetle, cucurbit stink bug, spotted beetle, pumpkin fruit fly, banded blister beetle and others)	1
4.4	Insect pests of okra, onion and garlic (Okra shoot and fruit borer, leaf hopper, onion thrips, whitefly, onion maggot and others)	1
5	Insect Pests of Fruits	
5.1	Insect pests of mango (Mango hopper, mango mealybug, mango stem borer, mango shoot gall maker, mango stone weevil, mango fruit fly)	1
5.2	Insect pests of citrus (Citrus stink bug, lemon butterfly, citrus red scale, citrus leaf miner, citrus psylla, brown citrus aphid, orange stem borer, citrus fruit fly and others)	1
5.3	Insect pests of banana (Banana rhizome weevil, banana skipper, banana pseudostem weevil, banana leaf and fruit scarring beetle, banana aphid and others)	1
5.4	Insect pests of litchi (Litchi bug, litchi leaf curl mite, red ant, bark eating caterpillar and others)	1
5.5	Insect pests of pomegranate, dragon fruit and kiwi (Pomegranate butterfly, bark eating caterpillar, scale, thrips, mealybug, aphid, and others)	1
5.6	Insect pests of apple and other temperate fruits (Woolly apple aphid, San Jose Scale, peach leaf curl aphid, codling moth, borer, tent caterpillar and others)	1
6	Insect Pests of Industrial crops and their Management	
6.1	Insect pests of sugarcane (Sugarcane top borer, early shoot borer, root borer,	1

	whitefly and others)	
6.2	Insect pests of jute (Jute mealybug, jute semilooper, jute stem weevil, jute hairy caterpillar and others)	1
6.3	Insect pests of cotton (Pink bollworm, cotton jassid, whitefly, American bollworm, cotton stem weevil, red cotton bug and others)	1
7	Insect Pests of Plantation crops, spices and condiments and their Management	
7.1	Insect pests of tea and coffee (Coffee white stem borer, coffee berry borer, leaf hopper, whitefly, tea mosquito bug, tea weevil, tea mites and others)	1
7.2	Insect pests of ginger, turmeric and cardamom (Shoot borer, leaf roller, rhizome scale, white grub, leaf beetle and others)	1
8	Insect Pests of Ornamental crops: rose, marigold, gladiolus, carnation and chrysanthemum (Aphid, leafhopper, whitefly, scale insects, thrips, leaf hopper, and others)	1
9	Insect Pests of Storage products and their Management	
9.1	Factors governing stored grain losses	1
9.2	Storage insect pests of cereals, pulses, oilseeds, flour, tubers and others (Rice weevil, maize weevil, granary weevil, rice moth, Angoumois grain moth, cowpea weevil, pulse beetle and others)	1
10	Major Vector Insects, rodents and their Management	
10.1	Insect vectors of plant and animal diseases and their management	1
10.2	Rodent and vertebrate pests and their management	1
11	Medical, Veterinary and Household insect pests	
11.1	Mosquitoes, louse, fleas, flies and cockroach	1
11.2	Ticks, mites and parasites	1
12	Pest Resistance, pesticide residues and health problems	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Periodic visits to farms for crop pests monitoring	1
2	Farm visit for collection and identification of predators and parasitoids	1
3	Farm visit for collection and identification of pollinators	1
4	Collection and identification of major insect pests of rice/ wheat	1
5	Collection and identification of major insect pests of maize/ millets	1
6	Collection and identification of major insect pests of pulse crops	1
7	Collection and identification of major insect pests of oilseed crops	1
8	Collection and identification of major insect pests of crucifer crops	1
9	Collection and identification of major insect pests of cucurbit crops	1
10	Collection and identification of major insect pests of solanaceous vegetables	1
11	Collection and identification of major insect pests of industrial crops	1
12	Collection and identification of major insect pests of tropical fruit crops	1
13	Collection and identification of major insect pests of sub-tropical/temperate fruit crops	1
14	Collection and identification of major insects pests of stored grains	1

15	Identification and management of rodents	1
	Total	15

Recommended Reading Materials

1. Atwal, A.S. and Dhaliwal, G.S. (2015). *Agricultural Pests of South Asia and their Management*. Kalyani Publishers, New Delhi, India.
2. Neupane, F.P. (2000). *Bali Biruwa Ka Satruharu Ra Tinka Roktham (Nepali)*. 4th ed. Sajha Prakashan, Kathmandu, Nepal.
3. Paneru, R.B. and Giri, Y.P. (2011). *Management of Economically Important Agricultural and Household Pests of Nepal*. NARC, Entomology Division, Khumaltar, Lalitpur, Nepal.
4. Panwar, V.P.S. (2017). *Agricultural Insect Pests of Crops and their Control*. 3rd ed. Kalyani Publishers, New Delhi, India.
5. Srivastava, K.P. and Butani, D.K. (2009). *Pest Management in Vegetables*. Stadium Press, New Delhi, India.
6. Tiwari, S. and Thapa, R. B. (2012). *Laboratory Manual of Economic Entomology*. Tribhubhan University, IAAS, Department of Entomology.

Course Code	ENT611
Course Title	Industrial Entomology
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to understand the clear concepts of beneficial insects such as honey bees, silkworms, lac insects and biological control agents and crop pollinators.

Course Description

Beneficial insects of food, medicine and aesthetic values; Commercialization of honey bees, silkworms, lac insects, bio-control agents; Crop pollinators and eco-environmental indicators.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction of Beekeeping	
1.1	Introduction, history of modern beekeeping, significance, problems and opportunities of beekeeping in Nepal	1
1.2	Major honeybee species in Nepal: exotic and indigenous	1
2	Honeybee castes, Biology and behavior of Honeybees	
2.1	Honeybee castes and biology	1
2.2	Major duties of queen, drone and workers	1
2.2	Honeybee communication, swarming, absconding, rubbing and migration	1
3	Honeybee Management	
3.1	Seasonal colony management for honey production	1

3.2	Artificial queen rearing and queen introduction in the colony	1
4	Honeybee Flora and Pollination	
4.1	Honeybee flora and foraging	1
4.2	Role of honeybees on crop pollination	1
5	Honeybee Problems: Pests, diseases and pesticide poisoning	1
6	Sericulture	
6.1	Definition, history, scope and prospects of sericulture in Nepal	1
6.2	Silkworm rearing technology, harvesting and processing	1
7	Lac culture: Introduction and industrial aspects of Lac insects	1
8	Different aspects of Industrial Entomology	
8.1	Industrial aspects of crop pollinators	1
8.2	Prospects on biological control agents	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study of insect products	1
2	Identification of different species of honeybees	1
3	Bee hives and tools used in beekeeping	1
4	Preparation of artificial feeds for different seasons	1
5	Queen preparation technique	1
6	Honey harvesting, processing and storage	1
7	Bee colony transfer and live hive transportation	1
8	Identification of bee flora: nectar, pollen and propolis sources	1
9	Bee keeping records and inventory	1
10	Mites and pests of honeybees	1
11	Silkworm life stages and feeding	1
12	Cleaning and disinfection of silkworm rearing room	1
13	Larval moulting, cocoon harvesting and grading of silkworm	1
14	Humidity, temperature and pest management in silkworm rearing	1
15	Laboratory rearing techniques of bio-control agents: parasitoids	1
	Total	15

Recommended Reading Materials

1. Abrol, D.P. (1997). *Bees and Beekeeping in India*. Kalyani Publishers, New Delhi, India.
2. Ganga, G. and Chetty, J.S. (1991). *An Introduction to Sericulture*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
3. Mishra, R.C. (1998). *Perspectives in Indian apiculture*. Agrobotanica, New Delhi, India.
4. Shukla, A.N. (2000). *Beekeeping Trainer's Resource Book (Nepali)*. ICIMOD, Kathmandu, Nepal.
5. Shukla, G. (2009). *Economic Zoology*. Rastogi Publications, Merrut, Uttar Pradesh, India.
6. SRDP/UNDP (1997). *Mulberry Cultivation and Management Booklet (Nepali)*. SRDP/UNDP. Santibasti, Lalitpur, Nepal.
7. Thapa, R.B. (ed.) (1998). *Sericulture Development Education (Nepali)*. SAN/WDA/WDP, Ilam, Nepal.

Plant Pathology

Course Code	PPA321
Course Title	Fundamentals of Plant Pathology
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
After completion of this course the students will be able to know the importance of microorganisms in agriculture, identify the major plant pathogens their survival, epidemiology, life cycle and general management practices.
Course Description
Introduction of major diseases causing organisms and plant diseases symptoms; General principles of plant pathology including epidemiology; Survival and dissemination; Physiology of infected plants and general management practices.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction, definitions, objectives of Plant Pathology	1
2	History of Plant Pathology with special reference to Nepal	1
3	Classification of plant diseases	1
4	Symptoms and sign of plant diseases	2
5	Definition and characteristics of fungi	1
6	Useful and harmfulness of fungi in human life (Include mushroom shortly)	1
7	Reproduction and fruiting bodies of fungi	1
8	Characteristics of major Fungal genera	4
8.1	Myxomycota: Plasmodiophora, Spongospora and Synchytrium Diplomastigomycotina: Pythium and Phytophthora	1
8.2	Diplomastigomycotina: Albugo, Sclerospora, Plasmopara and Peronospora	1
8.3	Ascomycotina: Taphrina, Protomyces, Erysiphe, Sclerotinia and Claviceps Basidiomycotina: Puccinia, Melampsora, Uromyces, Ustilago, Tilletia	1
8.4	Deuteromycotina: Colletotrichum, Alternaria Cercospora, Fusarium, Helminthosporium, Pyricularia, Sclerotium and Rhizoctonia	1
9	Characteristics of major Bacterial Disease	
9.1	Definition, general morphology of bacterial cell and their function	1
9.2	Characteristic of bacteria up to generic level: <i>Xanthomonas</i> , <i>Pseudomonas</i> , <i>Erwinia</i> , <i>Agrobacterium</i> , <i>Streptomyces</i>	1
10	Definition, characteristics of virus, examples of plant disease caused by virus	2

11	Transmission of plant viruses	1
12	Mycoplasma, Spiroplasma and Rickettsia	1
13	General characteristics of nematode with economically important diseases: <i>Anguina, Globodera, Meloidogyne, Heterodera</i>	1
14	Pathogenicity and Pathogenesis	1
15	Survival of the Pathogens	1
16	Dissemination of Pathogens	1
17	Epidemiology of Plant diseases	1
18	Physiology of Infected plants	1
19	Defense mechanism in plants	
19.1	Pre-exposed defense mechanisms of plants	
19.2	Post exposed defense mechanisms of plants	
20	Principles of Plant disease Management	1
21	Methods of Plant disease Management	2
22	Survey and surveillance of Plant diseases	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Acquaintance with laboratory equipment	1
2	Study about the microscope	1
3	Study on cleaning and sterilization of glass wares	2
4	Study on PDA medium preparation and its uses	1
5	Field visit to study some of the common diseases	1
6	Identification of plant diseases based on visible pathogens	1
7	Identification of plant diseases based on host pathogen interaction	1
8	Preparation of slide by teasing and identification of lower fungi	1
9	Identification of higher fungi	1
10	Identification of imperfect fungi	1
11	Extraction and identification of pathogenic and saprophyte nematodes	2
12	Calculation of disease incidence and severity	1
13	Calculation of fungicides requirements	1
	Total	15

Recommended Reading Materials

1. Agrios, G. N. (2005). *Plant Pathology. 5th Edition*: Elsevier Academic Press. Burlington, Ma. USA, 79-103.
2. Chaube, H. S. and Singh, R. (2015). *Introductory Plant Pathology*. CBS Publishers and Distributors Pvt. Limited.
3. Pandey, P. (2021). *Laboratory Manual and Workbook on Plant Pathology*.
4. Singh, R. S. (2017). *Introduction to Principles of Plant Pathology*. Oxford and IBH Publishing, New Delhi.

Course Code	PPA421
Course Title	Diseases of Agronomical Crops and their Management
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
After completion of this course, the students will be able to identify the major diseases of agronomical crops, their etiology, epidemiology, disease cycle and their management.
Course Description
Major diseases of rice, wheat, barley, maize, millet, pigeon pea, lentil, gram, mustard, groundnut, sesame, linseed, soybean, sugarcane, jute, cotton, tobacco, tea, coffee and rubber with special reference to Nepal; their symptoms, etiology, epidemiology disease cycle and management practices.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Major Diseases of Rice and Finger millet	
1.1	Rice blast, Brown spot, Sheath blight, False smut of rice	3
1.2	Bacterial leaf blight, Bacterial leaf streak of rice, Zinc deficiency in rice	2
1.3	Millet blast and leaf spot of millet	1
2	Diseases of Wheat and Barley	
2.1	Wheat rust: Brown, Black and Yellow rusts	1
2.2	Loose smut of wheat	1
2.3	Covered smut of barley, Foliar blight (Spot blotch and Tan spot)	1
2.4	Leaf spot, Powdery mildew of wheat	1
2.5	Ear cockle of wheat, Ergot of bajra	1
3	Maize Diseases	
3.1	Grey leaf spot of maize, Southern and Northern leaf blight of maize	2
3.2	Banded leaf and sheath blight of maize, Cob rot, stalk rots of maize	2
4	Diseases of Legumes	
4.1	Wilt of pigeon pea, lentil and chickpea	1
4.2	Stemphylium blight of lentil and Collar rot of lentil, Gray mold of chickpea	2
4.3	Pod blight of soybean, Soybean Mosaic, Rusts and Bacterial pustules of soybean, Bacterial Blight of soybean	2
4.4	Mosaic of blackgram, mungbean, cowpea	1
5	Diseases of Oilseed Crops	
5.1	Sclerotinia blight of mustard, white rust of crucifers	1
5.2	Tikka disease of ground nut, Rhizoctonia collar and root rot	2
5.3	Sesamum blight and linseed rust	1
6	Diseases of Commercial Crops	
6.1	Red rot of sugarcane, Smut of sugarcane	1
6.2	Collar and Root rot of jute	1

6.3	Cotton wilt, Root rot of cotton	1
6.4	Anthracnose and angular leaf spot of cotton	1
6.5	Tobacco damping off and TMV	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Collection and preservation of diseased samples	1
2	Preparation of PDA medium for isolation of fungi	1
3	Preparation of medium for bacterial isolation	1
4	Isolation of fungi from infected sample	1
5	Isolation of bacteria from infected sample	1
6	Pathogenicity tests	2
7	T. S. cutting for the study of host-parasite relationship of cereal disease	1
8	T. S. cutting for the study of host-parasite relationship of oilseed disease	1
9	T. S. cutting for the study of host-parasite relationship of pulse disease	1
10	Preparation of slide by teasing method and identification of pathogen	2
11	Seed treatment and spraying of chemicals	1
12	Field visit to identify the disease and learn disease scoring technique	1
13	Calculation of disease incidence and intensity	1
	Total	15

Recommended Reading Materials

1. Agrios, G. N. (2005). *Plant Pathology 5th Edition*: Elsevier Academic Press. Burlington, Ma. USA, 79-103.
2. Chaube, H. S., and Pundhir, V. S. (2005). *Crop Diseases and their Management*. PHI Learning Pvt. Ltd.
3. Pandey, P. (2021). *Laboratory Manual and Workbook on Plant Pathology*.
4. Rangaswami, G., and Mahadevan, A. (1998). *Diseases of Crop Plants in India*. PHI Learning Pvt. Ltd.
5. R S Mehrotra. and Aggarwal, A. (2017). *Plant Pathology*. McGraw Hill Education (India) Private Limited.
6. R.S. Singh (2005). *Plant Disease (8th edition)*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Course Code	PPA521
Course Title	Diseases of Horticultural Crops and their Management
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course	
After completion of this course, the students will be able to identify the major diseases of horticultural crops, their etiology, epidemiology, disease cycle and their management.	
Course Description	
Major diseases of summer vegetables, winter vegetables, temperate fruits, subtropical and tropical fruits, some spice crops with special reference to Nepal; their symptoms, etiology, epidemiology, disease cycle and management practices.	

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Late blight of potato and tomato	1
2	Early blight of potato and tomato, Septoria leaf spot of tomato	1
3	Potato wart and black scurf of potato	1
4	Damping off of vegetable seedlings and diseases of cut flowers	1
5	Sclerotinia blight of vegetables	1
6	Alternaria leaf spot of Cole crops, radish and broad leaf mustard	1
7	Club root of crucifers	1
8	Powdery mildew of pea, Rust of bean, Powdery and downy mildews of cucurbits	1
9.	Bean Anthracnose and White mold of French bean	1
10	Gummy Stem blight of cucurbit, Phomopsis blight of brinjal	1
11	Phytophthora blight of chilli, Cercospora leaf spot of chilli	1
12	Fruit Rot/ Die back of chilli	1
13	Stem gall of coriander, purple blotch of onion	1
14	Rhizome rot of ginger, Leaf blight of turmeric	1
15	Mango Malformation	1
16	Mango Anthracnose	1
17	Powdery mildew and downy mildew of grape	1
18	Peach leaf curl, Red rust of litchi	1
19	Panama wilt and Sigatoka leaf spot of banana	1
20	Apple scab, Papery bark of Apple	1
21	Papaya damping off, Ring spot disease of papaya	1
22	Guava wilt, Guava canker	1
23	Bacterial wilt of potato	1
24	Citrus canker and Citrus decline	1
25	Cucumber mosaic, Cowpea mosaic and Bean mosaic	1
26	Viral diseases of potato and tomato	1
27	Root knot nematode of vegetables	1
28	Rhizome rot and Chirkey and Foorkey disease of cardamom	1
29	Stem rot and Powdery mildew of rubber	1
30	Blister blight of tea and rubber and Red rust of tea	1
	Total	30
Course Breakdown (Practical)		
SN	Course Outline	Lectures

1	Field visit to identify the causative organisms of the diseases around the vicinity of college	1
2	Dry and wet preservation of collected sample of vegetable and fruit diseases	1
3	Preparation of PDA and other growth media	1
4	Isolation and multiplication of pathogen in growth media	1
5	Growing on test for fungal, viral and bacterial seed transmission	1
6	Isolation of bacteria from ooze test/infected sample	1
7	Isolation of nematode from infected sample	1
8	Preparation of bacterial growth media	1
9.	Transverse section cutting to study of host parasite interaction (fruit crop)	1
10	Transverse section cutting to study of host parasite interaction (vegetable crop)	1
11	Study disease incidence and intensity from the group work trail	1
12	Staining and identification of gram positive and gram negative bacteria	1
13	Study about market available botanical, biological and chemical fungicides	1
14	Study of seed borne pathogens from plating method	1
15	Seed treatment and foliar spray	1
	Total	15

Recommended Reading Materials

1. Agrios, G. N. (2005). *Plant Pathology 5th Edition*: Elsevier Academic Press. Burlington, Ma. USA, 79-103.
2. Pandey, P. (2021). *Laboratory Manual and Workbook on Plant Pathology*, 1st Ed.
3. R S Mehrotra. and Aggarwal, A (2017). *Plant Pathology*. McGraw Hill Education (India) Private Limited.
4. R.S. Singh (2005). *Plant Disease (8th edition)*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Verma, L. R., and Sharma, R. C. (1999). *Diseases of Horticultural Crops: Vegetables, Ornamentals, and Mushrooms*. Indus Publishing.
6. Verma, L. R., and Sharma, R. C. (1999). *Diseases of Horticultural Crops: Fruits*. Indus Publishing.

Course Code	PPA601
Course Title	Mushroom Cultivation
Credit Hours	1 (0+1)
Full Marks	25
Theory (Marks)	00
Practical (Marks)	25

Objective (s) of the Course

After the completion of this course, the students will be able to prepare pure culture, spawn production and cultivation of *Pleurotus* and *Agaricus* species of mushroom.

Course Description

Importance of mushrooms in human diet; Introduction of commercially cultivated mushroom in Nepal; Identification of edible and poisonous mushrooms, Isolation and maintenance of pure culture, grain spawn production; *Pleurotus* and *Agaricus* species: cultivation of *Pleurotus* and *Agaricus* species, and milky white mushroom.

Course Breakdown (Practical)

SN	Course Outline	Lectures
1	General characteristics of edible and poisonous mushrooms	1
2	Collection and preservation of native/wild (edible and poisonous) mushrooms	1
3	Major characteristics of <i>Pleurotus</i> (Oyster mushroom), <i>Volvariella</i> (Paddy straw mushroom)	1
4	Major characteristics of <i>Agaricus</i> (Button mushroom) <i>Lentinula</i> (Shiitake mushroom) and <i>Ganoderma</i> (Red mushroom) species, Milky white Mushroom (<i>Cilocybe indica</i>)	1
5	Potato Dextrose Media preparation and sterilization	1
6	Isolation and preparation of pure culture of <i>Pleurotus</i> spp	1
7	Preparation of grain spawn of <i>Pleurotus</i> spp	1
8	Sterilization of substrates by steaming and Chemical method	1
9	Spawning, bagging and incubation of Oyster mushroom	1
10	Cultivation of Oyster mushroom	1
11	Cultivation of Milky white mushroom	1
12	Harvesting of mushroom	1
13	Identification and management of diseases and insect pests	1
14	Recycling of mushroom compost	1
15	Visit to nearby mushroom farm and report writing	1
	Total	15

Recommended Reading Materials

- Chandra, R. (2016). *Mushroom Production Technology*. Banaras Hindu University, Department of Mycology and plant pathology, Institute of Agricultural Sciences, Varanasi. Pp.: 1-44.
- BISWAS, S., Datta, M., and Ngachan, S. V. (2011). *Mushrooms: A Manual for cultivation*. PHI Learning Pvt. Ltd.
- Khader, V. (1993). *Mushrooms for Livelihood*. Kalyani Publishers, India.
- Neupane, S. P. (2012). *Nepal ma Chyau Kheti*. Published by: Binita Neupane, Kathmandu, Nepal.
- Ram, R. C. (2007). *Mushrooms and their Cultivation Techniques*. Aavishkar Publication, Jaipur, India. Pp.: 1-155.

Social Science

Agricultural Economics and Agribusiness Management

Course Code	AEC121
Course Title	Fundamentals of Agricultural Economics
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon completion of this course, the students will be able to understand the general concept and principles of economics, particularly related with production, consumption and distribution.

Course Description

Economics: concept, meaning, definitions and scope of economics; Basic concepts of economic terms; Agricultural economics: meaning, definition, characteristics; Agricultural planning and development in the country; Utility theory: cardinal utility vs. ordinal utility, law of diminishing marginal utility; Indifference curve; Demand: law of demand, elasticity of demand; Price effect, income effect and substitution effect; Supply: law of supply, elasticity of supply; Production: factors of production, input-output relationship; Laws of returns: law of variable proportions and law of returns to scale; Cost concepts and cost curves; Market: market structure and price determination, perfect competition market, monopoly market, monopolistic market and oligopoly market; Distribution theory: characteristics of land and theories of rent, characteristics of labor and theories of wage; Characteristics of capital and theories of interest; National income: concepts and approaches to measurement; Population: Malthusian and Optimum population theories; Tax; Economic systems; Planning process and elements of economic planning.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Concept of economics; Definitions of economics and its evolution (Adam Smith, Marshall and Robbins)	1
2	Scope of economics (subject matter and nature); Brief description about the approaches to economic analysis (deductive and inductive); Microeconomics and macroeconomics; Positive and normative analysis	1
3	Nature of economic theory; Economic laws as generalization of human behavior; Basic concepts of: Rationality and Equilibrium	1
4	Basic concepts: Goods and services; Commodity; Value, cost and price; Need, want, wish, desire and demand	1

5	Basic concepts: Utility and its measurements; Income, wealth, capital and welfare; Consumption and satisfaction; Effort and means	1
6	Concept of agricultural economics; Characteristics of Nepalese agriculture and Nepalese farmers and its comparison in global scenario; Role/ importance of agriculture in the economic development of Nepal	1
7	Brief discussion on agricultural planning and development in the country	1
8	Law of diminishing marginal utility; Assumptions of the law of diminishing marginal utility; Exceptions of the law of diminishing marginal utility; Application of law of diminishing marginal utility in the case of money	1
9	Equi-marginal utility principle; Consumer's equilibrium and derivation of demand curve	1
10	Indifference curve and indifference schedule; Indifference map; Assumptions of indifference curve; Price line; Consumer's equilibrium through indifference curve analysis	1
11	Concept of demand; Determinants of demand (Demand Function); Demand schedule and demand curve; General concept about the changes in demand; Law of demand; Reasons for the law of demand; Exceptions for the law of demand; Use of the law of demand	1
12	Elasticity of demand: Price, income and cross-elasticity of demand; Types of different elasticities of demand; Measurement of the elasticity of demand	1
13	Price effect, income effect and substitution effect; Concept of consumer surplus	1
14	Concept of supply and stock; Supply schedule and supply curve; Law of supply; Determinants of supply; Elasticity of supply	1
15	Production: Process, creation of utility, factors of production, input-output relationship	1
16	Laws of returns: Law of variable proportions and law of returns to scale	1
17	Cost: cost concepts; Types of cost (fixed and variable cost; Explicit and implicit cost; Social cost; Opportunity cost)	1
18	Cost analysis: Total, average and marginal cost; Short-run and long-run cost curves	1
19	Market: Concept of market; Different types of market; Concept of firm and industry	1
20	Basic features of perfectly competitive market, monopoly market and monopolistic market; Brief introduction on oligopoly market	1
21	Price determination under perfect competition market	1
22	Price determination under imperfect market (monopoly and monopolistic market)	1
23	Distribution theory: Meaning; characteristics of land and theories of rent	1
24	Characteristics of labor and theories of wage	1
25	Characteristics of capital and theories of interest	1
26	Concept of national income, national income accounting and circular flow; Approaches for the measurement of national income accounting; Difficulties in measurement of national income	1
27	Population Studies: Concept of population and importance of population	1

	studies; Malthusian and Optimum population theory; Determinants of population; Brief discussion on the current Nepalese policies and programs related to population	
28	Tax: Concept of tax; Direct and indirect taxes; Value Added Tax (VAT); Brief discussion on agricultural taxation in Nepal	1
29	Economic systems: Concepts of economy and its functions; Important features of capitalistic, socialistic and mixed economies	1
30	Policy, plan and program; Planning process; Elements of economic planning	1
Total		30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Review of the different national/international source of agriculture related data and learn how to retrieve such data/information for use in research and study	1
2	Overview of Nepalese agriculture – analysis with the help of basic agricultural statistics and national accounts of Nepal	1
3	Role of agriculture from the point of view of the economic development of Nepal compared with its impact on a typical Nepalese farming household	1
4	Problems in the development of agriculture sector in Nepal and appropriate solution measures: analysis from the perspective of a typical farming household	1
5	Visit to the nearest agricultural farm/market and analysis of the demand for and supply of the selected (any one) agricultural commodities and compare/contrast field observation with the law of demand/supply	1
6	Measurement of the elasticity of demand/supply and explanation of the observed elasticity values	1
7	Study of the major institutions working for agricultural development in Nepal in relation with their role in agriculture and allied sector	1
8	Review of any one of the major existing national agricultural development program/ project	1
9	Preparing an inventory of the existing agriculture sector related acts, laws, rules, regulations, directives, policies and other such legal documents of Nepal	1
10	Review of the National Agricultural Policy (2004)	1
11	Review of different national periodic development plans with reference to the agriculture and allied sectors	1
12	Review of the Agricultural Prospective Plan/APP (1995/96-2014/15)	1
13	Review of the existing Agriculture Development Strategy/ADS (2015-2035)	1
14	Review of the international development efforts (Millennium Development Goals/MDGs, Sustainable Development Goals/SDGs, etc.) in relation with agriculture and allied sectors	2
Total		15

Recommended Reading Materials

1. Chopra, P.N. (2012). *Principles of Economics*. Kalyani Publishers, New Delhi.

2. Joshi, G.R. (2018). *Agricultural Economy of Nepal: Development Challenges and Opportunities*. Sustainable Research and Development Center, Kathmandu.
3. Koutsoyiannis, A. (2003). *Modern Microeconomics*. Palgrave Macmillan, U.K.
4. McConnell, C. R. (2001). *Economics: Principles, Problems, and Policies*. McGraw-Hill Publishing Co., USA.
5. Subba-Reddy, S., Raghu Ram, P., Sastry, T.V.N. and Devi, I.B. (2019). *Agricultural Economics*. Oxford and IBH Publishing Co. Pvt. Ltd., India.

Course Code	AEC221
Course Title	Farm Management and Resource Economics
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to understand the various aspects of farm management, different principles of production economics and the effective ways of managing available agricultural resources to obtain the optimum income from the farm businesses.

Course Description

Farm management: definition, scope and importance, relationship of farm management with other sciences; Farm management functions; Farm management decisions; Factors to be considered in selecting a farm; Terminologies: Definition and types of resources, cost and its types, product and its types, break-even point (BEP), benefit-cost ratio (BCR), factors of production, short-run and long-run production decisions, comparative advantage and competitive advantage; Production economics: concept of agricultural production economics, production function, classical production function and stages of production; Production relationships: factor-product relationship, factor-factor relationship, product-product relationship; Basic principles in farm management decisions; Farm resource management: land management, labor management, capital equipment management; Economies of scale: internal and external economies of scale; Farm planning and farm budgeting; Farm records and accounts; Farm inventory; Net worth statement (balance sheet); Depreciation of farm assets; Farm efficiency measures; Linear programming; Risk and uncertainty in agriculture; Project cycle: Assessment/ Analysis of a project (Payback period, Benefit-Cost Ratio, Net present Value, Internal Rate of Return, sensitivity analysis); Resources-Definition, types; Relationship between human and farm resources-different components of Nepalese farming system; Resources depletion and mitigation approaches; Economic valuation of natural resources: their use in policy development and evaluation; Climate change and land use regulation; Environmental plans and policies in Nepal and Institutions involved; EIA– Definition, importance and process.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Farm management: definition, scope and importance; Relationship of farm management with other sciences	1
2	Farm management functions: planning, organizing, staffing, directing and controlling functions; Basic skills and role of a farm manager	1
3	Farm management decisions: production and organizational decisions, administrative decisions and marketing decisions	1
4	Factors to be considered in selecting a farm: natural factors, artificial factors, other factors affecting farm selection	1
5	Resources and its types (fixed and variable; flow and stock); Product and its types	1
6	Short-run and long-run production decisions	1
7	Comparative and competitive advantage	1
8	Concept of agricultural production economics; Production function and production schedule; Continuous and discrete production function; Transformation period	1
9	Classical production function and analysis of the three stages of production	1
10	Production relationships: factor-product (input-output) relationship; Equilibrium point in case of input-output relationship (Maximization of net revenue)	1
11	Production relationships: factor-factor (input-input) relationship; Least cost combination	1
12	Production relationships: product-product relationship; Production Possibility Curve	1
13	Principles involved in farm management decisions: Principle of variable proportions	1
14	Principles involved in farm management decisions: Principle of factor substitution and Principle of product substitution (Law of equi-marginal returns)	1
15	Principles involved in farm management decisions: Cost principle and Opportunity cost principle (Principle of opportunity cost)	1
16	Principles involved in farm management decisions: Time comparison principle (Principle of time value of money)	1
17	Economies of scale: internal and external economies of scale	1
18	Farm planning: concept and importance; Characteristics of a good farm plan	1
19	Farm budgeting: concept, importance, and types of farm budgeting (partial and enterprise budgeting); Complete budgeting concept	1
20	Farm records and accounts: concept and importance; Types of farm records - physical farm records and financial farm records	1
21	Concept of farm inventory; Purpose and process of making farm inventory; Valuation of farm inventory (cost minus depreciation, cost or market price, net selling price, replacement cost minus depreciation, income capitalization) ; Selection of methods for valuation of farm assets	1

22	Concept of depreciation; Methods of computing depreciation (annual revaluation; straight line; diminishing balance; sum-of-the-year-digits / reducing fraction); Selection of methods for computing depreciation	1
23	Concept of Net Worth Statement / Balance sheet; Income Statement; Cash-flow Statement	1
24	Farm efficiency measures: profitability analysis, net worth analysis, liquidity analysis, solvency analysis	1
25	Farm resource management: land and labor management (only Economic/Financial aspect)	1
26	Farm resource management: machinery and farm building management (only Economic/Financial aspect)	1
27	Linear programming – concept, assumptions, and basic elements; application in agriculture with the help of graphical method	1
28	Linear programming – application in agriculture with the help of Simplex Method with two variables	1
29	Concept of risk and uncertainties in agriculture; Types of risk and uncertainties in agriculture	1
30	Risk management strategies in agriculture; Planning for managing risks	1
Total		30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Visit to a nearby farm and collection of farm's/farmer's data for the preparation of different farm records and farm financial analysis	1
2	Preparation of farm inventory (along with valuation of farm assets using appropriate methods) and computation of their depreciation using different methods	1
3	Preparation of different types of physical farm records	1
4	Preparation of Balance Sheet; Income Statement and Cash Flow Statement	1
5	Farm physical efficiency measures- Land use efficiency, labor use efficiency, machinery use efficiency, production efficiency	1
6	Farm financial efficiency measures- Profitability analysis, net worth analysis, liquidity analysis, solvency analysis	1
7	Analysis of Benefit-Cost Ratio, Net Present Value, Payback Period and Internal Rate of Return of the Firm	1
8	Sensitivity analysis: cost over-run and/or income depletion	1
9	Preparation of a farm budget: partial and enterprise budget	1
10	Comparison of different project based on time value of money	1
11	Determination of "least cost combination" of inputs of a farm	1
12	Determination of optimum input use (single input) and maximization of profit using input-output relationship	1
13	Determination of optimum product combination for revenue maximization using output-output relationship	1
14	Case Study (Group-wise/ choice of one among three broader topics as below): a. Agricultural risks and safeguarding measures	1

	b. Economic impact of climate change in agriculture c. Valuation of eco-system services	
15	Estimation of suitable production level of any two commodities based on linear programming principle	1
Total		15

Recommended Reading Materials

1. Chopra, P.N. (2012). *Principles of Economics*. Kalyani Publishers, New Delhi.
2. Debertin, D. L. (2012). *Agricultural Production Economics*. Create space Independent Pub., USA.
3. Johl, S. S. and Kapur, T. R. (2015). *Fundamentals of Farm Business Management*. Kalyani Publishers, India.
4. Kay, R. and Edwards, W. (2011). *Farm Management*. McGraw-Hill Education/Asia.
5. Subba-Reddy, Raghu Ram, S., P., Sastry, T. V. N. and Devi, I. B. (2019). *Agricultural Economics*. Oxford and IBH Publishing Co. Pvt. Ltd., India.

Course Code	AEC321
Course Title	Agriculture Finance and Cooperation
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon completion of this course, the students will be able to understand the issues of agricultural finance, microfinance and agricultural cooperation in rural, urban and international respective.
Course Description
Agriculture finance-meaning, scope and significance; Finance and management functions; Financial principles and decisions; Financial understanding of accounting concepts; Agricultural credit: meaning, need, role, classification and current status; Leveraging finance and partnerships with mainstream financial institutions; Credit demand and supply side situation in Agricultural sector; Credit analysis:4 R's and 3 C's; Introduction to cost of capital, debt, equity and opportunity cost of capital; Service providers in agriculture finance; Recent development in agricultural credit policy; Capital budgeting cum investment decisions; Fiduciary risk in agricultural financing: importance, risk type, risk-utility analysis, management and insurance; Financial statement and cash flow analysis; Introduction to public finance and public debt management; Microfinancing: definition, importance, scope, microfinance standards and principles; Introduction to micro-insurance and microcredit; Agriculture credit flow inclusion; Brief discussion of key institutions implementing microfinance programme; Microfinance model; Cooperatives and cooperation (definitions, principles, history, movement, facts and structure); Cooperative associations: self-help, volunteer and collective benefit; Agriculture cooperatives (types, structure, history, organogram, importance, laws and bylaws for registration, institutionalization and up-scaling); economic and financial viability of agriculture cooperatives; Cooperative marketing status in Nepal, and impact of agricultural cooperatives and cooperation.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Agricultural Finance- meaning, scope and significance	1
2	Finance and management functions	1
3	Financial principles and decisions	1
4	Financial understanding of accounting concepts: Credits, debt, liability, interest, saver, security, borrower, leverage, debit, savings, interest spread, savings, paid-up capital, share capital, bonds, debenture, Ripos , face/par value, redemption value, sinking fund, equity, net-worth, dividend, financial assets, loan amortization, equity capitalization, premium, fiduciary obligations, IBIT, security market and treasure bill	1
5	Agricultural credit: Meaning, need, role, classification and current status in Nepal	1
6	Leveraging finance and partnerships with mainstream financial institutions in Nepal and abroad: Agri, Dev. Bank, Nepal Rastra Bank, Commercial Banks, Development Banks, World Bank, Asian Dev. Bank, IMF, Treasury Bill	1
7	Credit demand and supply side situation in agricultural sector	1
8	Credit analysis:4 R's (repayment, refund, reimbursement, risk bearing) and 3 C's (character, capacity, capital)	1
9	Introduction to cost of capital, debt, equity and opportunity cost of capital	1
10	Service providers in agriculture finance: Non/semi/institutional sources as well as formal and informal source	1
11	Recent development in agricultural credit policy	1
12	Capital budgeting cum investment decisions	1
13	Fiduciary risk in Agricultural financing: Importance, risk type, risk-utility analysis	1
14	Fiduciary risk analysis and management strategies	1
15	Agriculture insurance: Importance, prospect, status and policies	1
16	Financial statement and cash flow analysis	1
17	Introduction to public finance and public debt management	1
18	Microfinancing: Definition, importance, scope, microfinance standards and principles	1
19	Introduction to micro-insurance and microcredit	1
20	Agriculture credit flow inclusion (by gender, ethnicity, geography and province)	1
21	Brief discussion of key institutions implementing microfinance programme (Gramin Bank, Rural Micro-finance Development Center Ltd (RMDC), Centre for micro-finance (CMF), Small Farmer Development Bank (SFDB)	1
22	Microfinance model: Private, Community-derive and Gramin Bank	1
23	Cooperatives and cooperation, definitions, principles, history and movement	1
24	Cooperatives: Facts, structure and figures	
25	The cooperative associations: Self-help, volunteer and collective benefit	1
26	Agriculture cooperatives: Types, structure, history, organogram and importance	1
27	Laws and bylaws of agriculture cooperative for registration, institutionalization	1

	and upscaling process	
28	Economic and financial viability of agriculture cooperatives	1
29	Cooperative marketing status in Nepal	1
30	Impact of agricultural cooperatives: Savings mobilization, credit access, inclusiveness, coverage, competitiveness, financial viability, and self-sustainability	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Organize excursion of student to commercial banks, MFIs, cooperatives and self-help groups to orient on savings and credit, loan flow, repayments and financial viability	1
2	Prepare balance sheet and analyses net-worth, equity, current capital ratios, working ratio and quick ratio	1
3	Prepare profit and loss account and analyze profitability ratios of viable agri-enterprises	1
4	Prepare cash-flow statement of any agriculture company or cooperatives	1
5	Prepare leverage ratios of viable agri-enterprises	1
6	Estimate inventory and operating ratios of viable agri-enterprise	1
7	Prepare a financial plan and its budgeting of any high value enterprise	1
8	Appraise investment evaluation criteria and acceptance rules for discounting techniques (NPV, IRR, profitability index, payback) and merits and demerits of each technique for above made financing	1
9	Appraise investment evaluation criteria, acceptance rules, merits and demerits of non-discounting techniques (payback, accounting rate of return, return on investment, break-even analysis) of above made financing	1
10	Calculate sensitivity analysis of agricultural financing	1
11	Study on financing and repayment requirements (policy and process) of nearby branch of Agriculture Development Bank	1
12	Study on financing and repayment requirements (policy and process) of nearby branch of any Commercial Bank	1
13	Study on financing and repayment requirements (policy and process) of nearby MFIs/ cooperatives	1
14	Study on financial feasibility and financial viability of nearby agricultural cooperatives or MFIs	1
15	Conduct seminar in value chain financing in agriculture for selected commodity	1
	Total	15

Recommended Reading Materials

1. DoC. (2011). *Cooperative Registration, Operation, Accounting, Monitoring and Regulation Standards, 2068*. Department of Cooperative, MOAC, GOV. (In Nepali)

2. Geman, H. (2015). *Agricultural Finance: From Crops to Land, Water and Infrastructure*. The Wiley Finance Series, John Wiley & Sons Inc.
3. Jha, K. K. (1978). *Agricultural Finance in Nepal: An Analytical Study*. South Asia Books, India.

Course Code	AEC420
Course Title	Agri-Business Management
Credit Hours	2+0
Full Marks	50
Theory (Marks)	50
Practical (Marks)	0

Objective (s) of the Course
Upon completion of this course, students will be able to understand how agriculture could be turned into a profitable business and how it could be optimally managed to provide ample economic opportunities to the adopting farmers.
Course Description
Definition, concept, scope and importance of agribusiness; Concept of agribusiness firm, plant, industry and their interrelationship; Agribusiness environment and management system; Supply chain and value chain management; Strategic production planning and planning tools in agribusiness management; Agribusiness plan; Organizational, business, and human resource management in agribusiness organization; Consumer demand analysis and forecasting; Financial and economic analysis of agribusiness; Agribusiness financing; Capital acquisition, agribusiness control and evaluation; Risk management in agribusiness; Marketing management in agribusiness; International trade, treaties and its impact in Nepalese agribusiness; Problem and prospect of Nepalese agribusiness; Comparative and competitive advantage of major commercial crops; Business ethics and social responsibility.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Definition and concept of Agribusiness; Differences between Agribusiness and Business	1
2	Scope and importance of Agribusiness management in Nepal	1
3	Basic concept and definition of Firm, Plant, Industry and their interrelationships with respect to agricultural production	1
4	Agribusiness enabling environments	1
5	Competition and globalization in the context of Agribusiness	1
6	Business ethics and social responsibility	1
7	Factors of production and Input-Output management in Agribusiness	1
8	Strategic planning and management in Agribusiness	1
9	Planning tools in Agribusiness management	1
10	Managerial roles and skills: Organizational and business management function and managerial decisions	1
11	Human resource management in Agribusiness organization	1

12	Leadership, motivation, and effective communication	1
13	Managing quality, operations, technology and information systems	1
14	Understanding consumer demand, consumption trend, and forecasting future Supply-Demand scenario of major Agribusiness products of Nepal	1
15	Demand forecasting of major Agribusiness products of Nepal	1
16	Preparation and analysis of Financial statements	1
17	Economic/ financial appraisal of Agribusiness firm	1
18	Agribusiness financing: Concept and importance	1
19	Economic principles involved in capital acquisition	1
20	Agribusiness plan: Concepts and elements	1
21	Preparation and analysis of Agribusiness plan	1
22	Risk management in Agribusiness	1
23	Concept of supply chain and value chain analysis	1
24	Value chain analysis and mapping of major commercial crops	1
25	Marketing management for Agribusiness firm: Strategic market planning, marketing mix, marketing decision tools	1
26	Implication of international trade and treaties in Nepalese agriculture sector and Agribusinesses	1
27	Study of major national and international Agribusiness	1
28	Impact of government policies on Nepalese Agribusiness Enterprises	1
29	Problem and prospect of Agribusiness in Nepal	1
30	Comparative and competitive advantage of some commercial crops (Cardamom and Coffee)	1
	Total	30

Recommended Reading Materials

1. Baker, G. A., Grunewald, O. and Gorman, W. D. (2001). *Introduction to Food and Agribusiness Management (First Edition)*. Prentice Hall, New Jersey, USA.
2. Barnard, F. L., Akridge, J. T., Dooley, F. J., Foltz J. C. and Yeager, E. A. (2016). *Agribusiness Management (Fifth Edition)*. Routledge (Taylor and Francis Group), New York, USA.
3. Beierlein, J. G., Schneeberger, K. C. and Osburn, D. D. (2014). *Principles of Agribusiness Management (Fifth Edition)*. Waveland Press Inc., Illinois, USA.
4. Downey, W. D. and Erickson, S. P. (1987). *Agribusiness Management (Second Edition)*. McGraw Hill, Pennsylvania, USA.
5. Ricketts, C. and Ricketts, K. G. (2008). *Agribusiness Fundamentals and Applications (Second Edition)*. Cengage Learning Inc., New York, USA.
6. Van-Fleet, D. Van-Fleet, E. and Seperich, G.J. (2014). *Agribusiness: Principles of Management*. Cengage Learning Inc., New York, USA.

Course Code	AEC521
Course Title	Agricultural Marketing, Trade and Prices
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon completion of this course, the student will be able to understand basics of marketing, especially with regards to the agricultural products, the theory and principles of agricultural trade, and the trend of agricultural product prices and factors affecting it in order to support them in appropriate decision-making for maximizing farm profits.
Course Description
Introduction to agricultural market and marketing, trade and prices; Nature of agricultural commodities; Classification of markets and marketing; Agricultural product prices; Theory of consumer behavior; Demand and supply functions; Consumers' and producers' surplus; Consumer behavior and supply chain management; Theory of firm; Marketing strategy; Market structure and equilibrium; Markets for agricultural inputs and their price determination; Marketing functions, market structure, market conduct and market performance; Price variation; Value chain development of agricultural products, risk management; Strategic market planning; Marketing research; Marketing efficiency; Regulation of agricultural markets; Public institutions in agricultural marketing.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Concept, role and importance of food and agricultural markets; rural versus food and agricultural market/ marketing	1
2	Marketing process and the marketing system; direct/ indirect marketing	1
3	Analyzing food and agricultural markets/ marketing	1
4	Nature of agricultural commodities and characteristics of agricultural product and input prices	1
5	Classification and form of agricultural markets based on different dimensions	1
6	Agricultural product prices: farm gate and food market prices	1
7	Theory of consumer behavior: concept of utility and approaches to measure utility, cardinal and ordinal approach; price, income and substitution effect	1
8	Demand function and factors affecting consumer behavior and market equilibrium	1
9	Consumers' and producers' surplus and welfare analysis	1
10	Elasticity: various elasticities of demand, supply	1
11	Relationship among elasticities and application of demand and supply elasticities	1
12	Consumer behavior and supply chain management	1
13	Theory of firm, characteristics of firm, supply function and its derivation, life	1

	cycle and development of products	
14	Marketing strategy, market and product promotions	1
15	Market structure and equilibrium: marketable surplus, market structure, market development and competition	1
16	Agricultural input market, cost of production, product quality, price determination and price discrimination	1
17	Marketing functions, physical, exchange and facilitating functions, role of marketing functions	1
18	Marketing channels and their significance	
19	Marketing costs, marketing margins, and price spread	1
20	Price variation, price movement over time, seasonal, annual, trend, irregular and cyclic price variation, spatial price variation	1
21	Spatial distribution of commodities, market boundaries and regional equilibrium models	1
22	Agricultural product processing, value chain development, horizontal integration, and vertical coordination and contracting in agricultural markets	1
23	Market risk assessment and management, strategic marketing plan, market planning tool, and off matrix	1
24	Marketing research: research in agricultural marketing, type and importance of marketing research, technical and economic marketing efficiency and its measurement	1
25	Marketing regulation and government intervention: nature and role of public institutions in product pricing, agricultural marketing, and factors mobility	1
26	Public institutions related to production, marketing and their promotion	1
27	Concept of domestic and international trade, gains and limitations of international trade and theories of international trade	1
28	Balance of trade, terms of trade: concept, types, effect and measurement; balance of payments: trade relation of Nepal with India and China	1
29	Tariff and its effects: optimum tariff, subsidy, quotas, dumping, state trading	1
30	Agricultural trade policy issues raised by WTO, SAPTA, GATT	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Collection of secondary data on demand, price and supply for a particular commodity, and estimate demand function, supply function and elasticities of demand and supply	1
2	Marketing channels, cost of production, price spread, marketing margin, marketing cost and marketing efficiency	1
3	Analysis of dual role of farmers as producer and retailer	1
4	Marketing middleman, agents and their role in agricultural marketing	1
5	Case studies on cooperative marketing, haat bazaar, collective marketing, wholesale market and retail market	1
6	Value chain analysis of agricultural products	1

7	Risk assessment and management strategies in agricultural marketing	1
8	Opportunities of value chain participation by farmers: problems and prospects	1
9	Cost of marketing, economics of marketing functions and price determination of agricultural products	1
10	Price variation: spatial, premium price and temporal (daily, within day, monthly, seasonal, irregular, cyclical, trend)	1
11	Market information system, use of IT on market information system and its importance	1
12	Strategic marketing plan preparation for selected commodities	1
13	Price determination and marketing efficiency	1
14	Collection of secondary data on export and import of agricultural products and inputs, and relative position and trend of international trade positions	1
15	Balance of trade, terms of trade and balance of payment	1
	Total	15

Recommended Reading Materials

1. Crawford, I. M. (1997). *Marketing Research and Information Systems*. Food and Agriculture Organization of the United Nation, Italy.
2. Ferris, J. N. (2005). *Agricultural Prices and Commodity Market Analysis (Second Edition)*. Michigan State University Press, US.
3. Hudson, D. (2006). *Agricultural Markets and Prices (First Edition)*. Wiley-Blackwell, US.
4. Kohls, R. L. and J. N. Uhl. (2015). *Marketing of Agricultural Products (Ninth Edition)*. Pearson India Education Services Pvt. Ltd., India.
5. Koutsoyiannis, A. K. (2008). *Modern Microeconomics (Second Edition)*. MacMillan Press Ltd., India.
6. Norwood, B. and Lusk, J. (2007). *Agricultural Marketing and Price Analysis (First Edition)*. Pearson Education Ltd., UK.
7. Rhodes, V. J., Dauve J. L. and Parcell, J. L. (2006). *The Agricultural Marketing System (Sixth Edition)*. Holcomb Hathaway Publishers, US.
8. Tomek, W. G. and Kaiser, H. M. (2014). *Agricultural Product Prices (Fifth Edition)*. Cornell University Press, US.

Course Code	AEC621
Course Title	Project Planning and Evaluation
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
To provide basic understanding of PME theory, approaches, methods and practice for effective and responsive programme execution with building on real world challenges.
Course Description

An introduction to Project Cycle Management; Development theories result based management; Project planning: National planning process, planning approaches, programme logic, annual plan implementation arrangement; Monitoring and evaluation: Concept, definition, approaches, national M and E framework, indicators, M and E plan, data collection approach, data collection, report preparation, communication and use of feedback; Evaluation types and approaches, scope of evaluation, evaluation ethics and standard, evaluation criteria, evaluation framework, methods and tools for data collection, evaluation report and use of evaluation.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Development history, theories and practices; Basic understanding of Policy, Program and Project	1
2	Understanding of Planning, Monitoring and Evaluation; Project Cycle Management and Result based management	1
3	Project Cycle Management and Result based management - Real world challenges of project management	1
4	Project/ Program Planning: Theory and importance in development management	1
5	Brief discussion on the Nepalese planning process (Federal, Regional or Provincial and Local or Palika-level)	1
6	Planning approaches: Aligning with the national and local priorities, understanding of socio-economic aspect and financial analysis	1
7	Introduction to program logic and development of program logic (log frame, theory of change) considering risks, driving factors and assumptions	1
8	Preparation of annual action plan with Gantt chart and responsibility	1
9	Implementation strategy/ arrangement: Adaptive management (planning/ managing in difficult situations) and stakeholder engagement	1
10	Process and roles in execution of the interventions and carrying out monitoring and evaluation, communication strategy	1
11	Understanding of monitoring and evaluation (concept, definition, similarity and differences); National Monitoring and Evaluation policies and frameworks	1
12	Monitoring and Evaluation approaches and history	1
13	Role of monitoring (on-going performance assessment and improvement) and potential challenges (data collection, skills of use, data analysis, financial resource, use of feedback)	1
14	Indicators and its types (using SMART approach)	1
15	Development of Monitoring and Evaluation plan (elements – methods)	1
16	Development of Monitoring and Evaluation plan (elements – role, resources and time)	1
17	Data collection approach: Qualitative and quantitative, use of new technology including virtual technology and other tools	1
18	Monitoring data collection (data collection design, data cleaning and analysis)	1
19	Report preparation and communication	1

20	Use of feedback in improvement of project implementation	1
21	Evaluation types: Formative and summative, ex-ante, on-going, ex-post, impact evaluation; Qualitative and quantitative evaluation: external, internal and joint evaluation	1
22	Evaluation approaches: Goal based, goal free, utilization focused, developmental	1
23	Developing scope of evaluation (review of programme logic, assess whether it is appropriate to evaluation, assessment of resources required, developing ToRs)	1
24	Understanding of evaluation ethics (guideline for evaluators – what should (not) be done and standards) – utility, feasibility, proprietary, accuracy	1
25	Understanding of evaluation criteria: OECD DAC criteria for evaluation – relevancy, coherence, effectiveness, efficiency, impact and sustainability	1
26	Developing Evaluation framework: Identifying evaluation questions, selection of indicators	1
27	Developing Evaluation framework: Selection of evaluation methods (virtual or face-to-face survey, FGD, transect walk, KIS)	1
28	Methods/ tools for sampling of projects sites and beneficiaries	1
29	Evaluation data collection; Data type: Qualitative and quantitative; Data analysis- qualitative and quantitative	1
30	Evaluation report sharing with stakeholders and beneficiaries, main elements of an evaluation report; Use of evaluation management response to evaluation	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Project Planning: Situation and problem analysis	1
2	Project Planning: Development of log-frame, formulation of objectives, outcomes and outputs with key performance indicators	1
3	Project Planning: Development of work plan and Gantt chart	1
4	Project Monitoring: Development of indicators and M and E plan	1
5	Project evaluation: Development of ToRs for evaluation including criteria of a project	1
6	Project evaluation: Development of evaluation framework	1
7	Project Monitoring: Organization visit (to observe their M and E Plan and understanding of challenges)	1
8	Project Monitoring: Preparation of monitoring report	2
9	Project Monitoring: Presentation of monitoring report	1
10	Project evaluation: Project site visit to carry out a rapid evaluation	2
11	Project evaluation: Preparation of evaluation report	2
12	Project evaluation: Presentation of evaluation report	1
	Total	15

Recommended Reading Materials

1. GoN. (2017). *Local Government Operation Act 2074*. Government of Nepal, Kathmandu, Nepal.
2. NPC. (2013). *National Monitoring and Evaluation Guidelines*. National Planning Commission, Government of Nepal, Kathmandu, Nepal.
3. NPC. (2018). *M and E Action Plan 2075/76*. National Planning Commission, Government of Nepal, Kathmandu, Nepal.
4. NPC. (2020). *The Fifteenth Five Year Plan (Fiscal year 2019/20 - 2023/24)*. National Planning Commission, Government of Nepal, Kathmandu, Nepal.

Course Code	AEC701
Course Title	Economics of Crop and Animal Production
Credit Hours	0+1
Full Marks	25
Theory (Marks)	00
Practical (Marks)	25

Objective (s) of the Course	
To equip students with the knowledge of economic and financial analysis of crop and livestock enterprises.	
Course Description	
Link commodity-based entrepreneurship learning with economic/financial analysis; Learning of production economics involved in at least one each of the agronomical crops, horticultural crops and livestock animals. This course will be linked with “Agri-Enterprise Development” courses offered by Agronomy, Horticulture and Animal Science Division. Students (single or a group of students) will be offered this course from 5 th to 7 th semester as per their selected “Agri-Enterprise Development” course. In the three semester, all the students will get a chance to analyze the economics of agronomical crop production, horticultural crop production and animal production. The course will be completed only when all the three project reports are submitted.	

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Preparation of Enterprise Budget	1
2	Preparation of detail Business Plan 2.1. Business Analysis and Production Plan 2.2. Business Management Plan 2.3. Business Development Plan 2.4. Financial Analysis and Funding Plan 2.5. Market and Competitive Analysis and Marketing Plan/Strategy	5
3	Detail recording of different financial data during the production process (including recording of any deviations from the initial plan) based on prepared protocol 3.1. Agronomical Crops 3.2. Horticultural Crops	3

	3.3. Livestock Animals	
4	Preparation of different physical/financial records based on field data 6.1. Agronomical Crops 6.2. Horticultural Crops 6.3. Livestock Animals	3
5	Analysis of Benefit-Cost Ratio, Net Present Value, Payback Period and Internal Rate of Return of the Firm based on simulation of recorded data for at least 10 years period with due consideration for market price index (inflation)	1
6	Analysis of sensitivity of the selected enterprise based on recorded data and possible changes in market scenario (cost of inputs and price of outputs), including analysis of extreme scenarios	1
7	Analysis of different physical and financial ratios to calculate the economics of production of agricultural commodity under consideration	1
Total		15

Recommended Reading Materials

1. FAO. (2018). *Seeds Toolkit - Module 1: Development of small-scale seed enterprises*. The Food and Agriculture Organization of the United Nations, Italy.
2. GoN and ADB. (2017). *Agribusiness Grant Facility Guideline 2072*. Raising Incomes of Small and Medium Farmers Project, Government of Nepal and Asian Development Bank, Nepal.
3. Johl, S. S. and Kapur, T. R. (2015). *Fundamentals of Farm Business Management*. Kalyani Publishers, India.
4. Khan, M. Y. and Jain, P. K. (2014). *Financial Management - Text, Problems and Cases*. Mc Graw Hill, India.
5. Subba-Reddy, Raghu Ram, S., P., Sastry, T. V. N. and Devi, I. B. (2019). *Agricultural Economics*. Oxford and IBH Publishing Co. Pvt. Ltd., India.

Agricultural Extension

Course Code	AEX121
Course Title	Rural Sociology and Educational Psychology`
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
To impart knowledge to the students on sociological and psychological aspects of rural people and to acquaint with some important features of rural society and application in the field of agriculture.
Course Description
Rural Sociology - Meaning, nature, scope and relationship, importance, social values and attitudes; Nepalese rural society, rural urban continuum, social groups, social process, social

movement, social stratification, inequality, culture concepts; Rural-social institutions, social problems and their solution, socialization, social change, social system, social deviance, social control; Leadership; Educational psychology- Meaning, concept; Education, learning: Learning theories, basic psychological concepts; Motivation, emotions, attitudes, social perception.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1.	Sociology: Meaning, nature, scope, school of thought	1
2	Rural Sociology: Meaning and importance in agrarian society; Rural- urban continuum	1
3	Cultural Value System - Meaning, concept, definition, types	1
4	Nepalese Rural Society: Characteristics; Cultural concepts - Culture, Customs, Folkways, Morales, Taboos, Rituals and Traditions - Meaning, definition and their role in Agricultural society	1
5	Rituals, festivals and ceremonies in different ethnicity of FWP	1
6	Nepalese Rural Society, Far Western Rural Societies: Introduction and characteristics (culture, rituals and traditions)	1
7	Social Groups: Meaning and definition, classification of groups	1
8	Social Processes (process of social interaction): Basic concepts, social amalgamation, assimilation, cooperation, competition, enculturation, acculturation, integration	1
9	Conflict: Stages, conflict intensity continuum, conflict management (accommodation, adjustment, consensus, collaboration) process, conflict management techniques	1
10	Social Movement: Meaning and causes of social movement, early and recent theories, types of social movement	1
11	Social Stratification: Meaning, bases (class, caste, age, gender), viewpoints (Theories) on stratification: functional, Marx and Max Weber	1
12	Social Stratification and Inequality: Caste/ ethnic and regional exclusion in Nepal and FWP (with example)	1
13	Introduction of agrarian society of Far-Western Terai and their social and agricultural characteristics	1
14	Introduction of agrarian society of Far-Western Hilly regions (lower, mid and upper) and their social and agricultural characteristics	1
15	Rural-social Institutions: Concept and functions	1
	(a) Social Institutions: Household, family types, marriage system	1
	(b) Economic Institutions: Farming system in Far- Western Province, Bank and Cooperatives, Agriculture and Livestock Industry.	1
	(c) Educational Institution; Political Institutions: level of governments	1
	(d) Religious institutions: Types of religion, their maintenance and followers	1
16	Social System: Meaning and elements of social system	1
17	Socialization: Meaning, stages and agents of socialization	1
18	Overview of theories of socialization/ self by Cooley, Mead and Freud	1
19	Social Change: Meaning, factors and theories of social change and impact of technology in rural society	1

20	Social Deviance and Social Control: Meaning, types, mechanisms	1
21	Education, Psychology, Educational psychology: Definitions and concept	1
22	Basic principles of human behavior – Sensation, Attention, Perception: Meaning, characteristics	1
23	Concept of learning: Three domains of learning Types of learners: Theorist, pragmatist, reflectors and activist Learning cycles: Conceptualization, construction and the dialogue	1
24	Learning theories: Learning theories and Thorndike's four Law of learning	1
25	Effective teaching learning elements, teaching learning process Factors affecting effective teaching learning situation	1
26	Basic psychological concepts; Intelligence and Personality (Big five personality)	1
27	Motivation: Concept, definition theories (Maslow, Heignberg's, X, Y and Z); Significance in teaching and learning.	1
28	Methods of educational psychology: Introspection, observation, clinical methods, sociometry	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Visit to a village in Tikapur (Eg. Bangaun/ Rampur/ Ghiya/ Dhansingpur/ Khakraula/ Asneri) to study the characteristics of rural society	1
2	Study of rural social institutions and organizations - School or cooperative or rural municipality/ local government authorities/ Bank (study the function and organogram)	1
3	Visit to a rural community to identify different social groups (user groups, farmers' groups and saving groups) to which the farmers are associated	1
4	Visit to a village to list out the taboos and folkways common in the village	1
5	Identification of important value systems in the rural setting as a means of social control	1
6	Identification of rural personality traits that affect the development of personality in rural situation	1
7	Conducting role play technique by the students to exhibit different conflict management (group exercise)	1
8	Listing social problems in rural society (group exercise)	1
9	Mitigation measures of social problems (group discussion)	1
10	Practice on personality and intelligence measurement techniques (group exercise)	1
11	To study behavior of farmers during crop harvesting (direct participatory observation)	1
12	To study behavior of farmers during marketing of product in Haat-bazar (indirect participatory observation)	1
13	Practicing sociometry (group exercise)	1
14	Study of different strata in society (Gender/ Class/ Ethnicity and Caste/ Age/	1

	Regional)	
15	Identification of agricultural technologies with pros. and cons. perceived in rural society	1
	Total	15

Recommended Reading Materials

1. Bhushan, V. and Sachdeva, D. R. (1994). *An Introduction to Sociology*. Kitab Mahal, Allahabad, India.
2. Chitambar, J. B. (1973). *Introductory Rural Sociology*. Wiley Eastern Limited, India.
3. Regmi, R. R. (2001). *The Essentials of Sociology*. Published by Sandeep Raj Regmi, Kathmandu, Nepal.
4. Rao, U. (2008). *Advanced Educational Psychology*. Himalaya Publishing House, New Delhi.

Course Code	AEX421
Course Title	Agricultural Extension
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

Upon the completion of this course, the students will be able to understand the basic concept of education and extension education, their principle, philosophy, objective, method, system and practices etc. This course will be helpful to develop student's understanding and ability to apply the agricultural extension knowledge to the farming community.

Course Description

Meaning, concept, definition and type of education and extension education, their objective, role in agricultural development; Principle, philosophy and method of extension education derived from psychology of education and their application to agricultural extension; Historical perspective of extension education and scope of agricultural extension, their system, organizational setup and method used in extension education; Extension teaching learning process, agricultural technology and transfer of technology; Program planning and their characteristics, type, level and principle of good program planning process; Identification, characteristics, selection of local leader and their roles in agricultural extension program; Role, function, organizational setup of Land Grant System model of Agricultural College and University in agriculture development; Monitoring and evaluation of extension program.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Objectives and role of non-formal education in agricultural development	1
2	Concept of pedagogy and andragogy; Adult learning characteristics and principle of adult learning	1
3	Meaning, concept, definition of extension and extension education	1
4	Scope, objectives and role of extension in agricultural development	1
5	Principle and philosophy of extension education	1

6	Historical events and different approaches of extension used worldwide	1
7	History of extension and extension education in Nepal	1
8	Extension approaches: Extension approaches used in Nepal (Conventional , IRDP, T and V, BPP, TUKI , F to F)	1
9	Contemporary extension approaches (Privatization, Projectization, Pluralistic Extension and Group approach, Farmers Field School)	1
10	Group concept, types, stage of formation and uses of group in agricultural development	1
11	Extension teaching method: Individual, group and mass method	1
12	ICT and social media as extension teaching methods	1
13	Concept of innovation diffusion process and stages of adoption process	1
14	Categories of farmers based on the technology adoption and factors affecting rate of adoption	1
15	Transfer of technology in agriculture: Concept of agricultural technology and sustainable technology and models of TOT (Conventional, feedback and Farmers participatory)	1
16	Role of extension agent in transfer of technology and emerging concept in TOT (FSRE, PTD, PRA, RRA)	1
17	Basic concept of leader and leadership development and their qualities	1
18	Types, selection, utilization, role of local leader in rural development program	1
19	Basic concept, meaning, scope, objective, principle of program planning in agricultural extension	1
20	Models and steps of program planning cycle in agriculture	1
21	Agricultural extension and advisory service delivery system in federal Nepal	1
22	Agricultural extension and advisory service system in Far Western Province	1
23	Concept of farmers training: Training phases (pre training, during training and post training) and steps in farmers training	1
24	Monitoring and evaluation: Concept, type and differences between monitoring and evaluation; Monitoring and evaluation indicators: input, process, output and impact indicators	1
25	Participatory monitoring and evaluation; Tools for participatory monitoring and evaluation	1
26	Land Grant System (LGS) and role of Nepalese university (AFU, TU, PU, FWU and MWU) in agriculture development.	1
27	Research-Extension and Education system (REE) linkage in Nepal; Importance of REE linkage in agricultural development	1
28	Research in Agricultural Extension: Areas of research, models (qualitative and quantitative research), importance of research in agricultural extension	1
29	Updates in Agricultural Extension (Teacher's review)	2
	Total	30
Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	A visit to individual farm (Agriculture/Crop) for experience sharing	1
2	A visit to individual farm (Livestock) for experience sharing	1

3	Interaction visit and meeting with AKC, DLS, NGOs, ADB/N, Zone/ Superzone and study their program planning process, plan of work, organizational setup and calendar of operation	3
4	Formation and planning for group farming in campus area	1
5	Visit and observation of agricultural and livestock section of local government at the grass root level study their program planning process, plan of work and implementation	2
6	Conduction of method demonstration (group work)	1
7	Conduction of result demonstration (group work)	1
8	Focus Group Discussion with farmers (Agriculture, livestock)	1
9	Interview schedule preparation and use of interview schedule in collection of data from the farmers	2
10	Visit/participate in FFS and/ or farmers training	1
11	Organize/participate in an agricultural fair/exhibition	1
	Total	15

Recommended Reading Materials

1. Van Den Ban A. W. and Hawkins, H. S. (1988). *Agricultural Extension*. Longman Scientific and Technical Co-published with John Wiley and Sons Inc., New York, US.
2. Dongol, B. B. S. (2004). *Extension Education*. Prativa Singh Dongol Printers, Kathmandu, Nepal.
3. Dahama, O. P. and Bhatnagar. O.P. (1998). *Education and Communication for Development*. Oxford and IBH Publishing Co. Ltd., New Delhi, India.

Course Code	AEX611
Course Title	Agricultural Communication
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
Upon the completion of this course, the students will be able to understand the basic concept of communication, their principle, method, type, system and media preparation etc. and this course will be helpful to develop student's understanding and ability to apply the agricultural communication knowledge to be dissemination to the farming community.
Course Description
Meaning, concept, definition scope and type of communication, their process, function role in agricultural development; Element, process and model of communication; Feedback, barriers and theory of communication, its type and approaches; Planning for effective communication; Present trend, issues in agricultural communication; Communication in satellite system, role of governmental and non-governmental agencies in agricultural communication and development.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Communication: Meaning, concept and definition; Importance and scope of communication	1
2	Role / function, process and elements of communication	1
3	Feedback, form and models of communication	1
4	Barriers of communication: Physical, psychological, social and cultural	1
5	Fundamental theories of mass communication: 1) the magic bullet theory, 2) two-step flow theory, 3) multi-step flow theory, 4) uses and gratification theory, and 5) cultivation theory	1
6	Principles of communication	1
7	Effective communication in an organization: Concept, meaning and importance of Organizational Communication	1
8	Concept of ICT and use of ICT in agricultural development	1
9	Communication/ press policies in Nepal	1
10	Meaning, concept, definition, scope and importance of information management	1
11	Communication approaches: Communication considerations involved in developing successful projects/ programs in the world, South-East Asia and SAARC	1
12	Planning for effective communication in agricultural development, trend issue and problem	1
13	New trend and issues in agricultural communication, media - mix	1
14	Satellite system in communication	1
15	Research in communication: Areas, Models and Methods	1

	Total	15
Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Data representation :Line, Bar, Pie and Pictorial graphs	1
2	Preparation of various kind of charts – Flow, tree, suspense, flip etc.	1
3	Preparation of pamphlet, leaflet and booklet	2
4	Preparation of poster and pictorial book	1
5	Folk song competition among the students	1
6	Preparation and presentation of street drama	1
7	Organization/observation of poster/booklet exhibition	1
8	Communication through bulletin, Flannel and magnetic board.	1
9	Observation and safety use of projector and film/ movie projector	1
10	Study of mobile based application in dissemination of agricultural information	1
11	Visit to local radio station and prepare script for agricultural program	1
12	Communication skill development, presentation skill through MS Power point	1
13	Date collection/ report writing about the effectiveness of local radio/newspaper/ TV in dissemination of agricultural information	1
14	Designing the content suitable to use in Social Media (Facebook, twitter, Instagram, YouTube)	1
	Total	15

Recommended Reading Materials

1. Lionberger, H. F. and Gwin. P. H. (1982). *Communication Strategies – A Guide for Agricultural Change*. University of Missouri, Columbia, US.
2. Dahama, O. P. and Bhatnagar, O.P. (1998). *Education and Communication for Development*. Oxford and IBH Publishing Co. Ltd., New Delhi, India.
3. Oakley, P. and Garforth, C. (1985). *A guide to Extension Training*. University of Reading, UK.

Course Code	AEX721
Course Title	Social Mobilization and Community Development
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
This course will enable the student to select and apply the most appropriate process, approach and techniques in developing rural and community development program by appreciating the importance of socially organized groups and their mobilization in the development activities and will also empower the students to make wise on the use of gender concept and participatory learning tools related to development in most relevant ways.
Course Description
Concept of development, development indicators, dimension, theories, trends, approach and its characteristics; Concept principle and strategies of sustainable development; Community development: Concept, types, principle, characteristics and steps; Modernization, modern society; Relative deprivation and human poverty, poverty, poverty alleviation; Social mobilization; Decentralization for development: Practices, strategies and issues in Nepal; Gender: Concept and terminologies; Concept of migration, remittance use in agriculture, and gender implication of migration; Social mobilization: Concept, process, typologies, stage and challenges, history of social mobilization, participatory planning in social mobilization process, monitoring and evaluation of social mobilization, participatory learning and action tools for social mobilization.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Concept of development: Development characteristics, indicators, dimension; Difference between change growth and the development	1
2	Overviews of development theories: Economic and non-economic theories of development	1
3	Overview of approach, trends and development practice of Nepal	1
4	Concept of modernization: Overview of modernization theory Rostow's model of economic development; Major process of change in modernization process	1
5	Concept, principle and strategies of sustainable development	1
6	Concept of community and society: Basic characteristics of community; Community development: Process, methods, program and procedure; Guiding principle, type of community development program	1
7	Basic values of community development; Basic steps of community development	1
8	Relative deprivation, human poverty and human poverty index; Methods of calculating human poverty index and human development index	1
9	Concept and definition of decentralization and principle of subsidiary;	1

	Forms of decentralization, brief history of decentralization practice in Nepal	
10	Overview of local government reforms and federalization in Nepal	1
11	Major characteristics of current decentralization practice of Nepal; Advantage, disadvantage, issues of decentralization practice in Nepal	1
12	Concept of sex and gender, gender stereotypes, gender roles and gender need; Social stratification and gender, gender based discrimination in Nepal; Concept of equity and equality	1
13	Gender analysis and guiding question, Gender analysis tools; Gender sensitive planning, Gender budgeting; Gender mainstreaming: Process and procedure, domains and level of change; GoN action for gender mainstreaming	1
14	Concept of social inclusion social inclusion mapping; BPFA, CEDAW, Gender and social inclusion strategies and action	1
15	Origin and concept of WID, WAD, GAD and its differences	1
16	Concept of migration, remittance, current migration and remittance status; Migration and its gender implication in development; Positive and negative consequences of migration in development	1
17	Social mobilization: Definition, concept and meaning; Transformational and transactional social mobilization; Social mobilization and social transformation process	1
18	Concept, meaning and purpose of social mobilization; Terminologies and typologies of social mobilization	1
19	Conceptual and program package of social mobilization	1
20	Stage/phases/dialogue of social mobilization	1
21	Qualities of social mobilizer: Social mobilization brand; Social mobilization and good governance	1
22	Relationship of poverty alleviation and social mobilization	1
23	Participatory planning in social mobilization process; Principle and assumption of participatory planning; Major portfolio of planning	1
24	Major activities of program planning of social mobilization; Fundamental question preparation before planning step of planning cycle	1
25	Implementation process and procedure of social mobilization; Challenges and issues of implementation of social mobilization	1
26	Participatory learning and action tools for social mobilization; Concept of PRA, RRA, PLA and its use in development; Tools and techniques of PRA/RRA used in social mobilization process	1
27	Discussion and interview: Focused group discussion, semi structured interview	1
28	Diagram and mapping: Resource mapping, Venn diagram, Social mapping, Mobility map, Daily activity profile, Problem solving tree, Seasonal calendar	1
29	Updates in concept of development, gender and decentralization (Teacher's Review)	2
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	A visit to DDC/ Municipality/ Rural municipality to study social mobilization processes	1
2	Study of resource mobilization/social mobilization guidelines of GoN	1
3	Case study of rural development/ community program implementing in Nepal	1
4	Sensitization of participatory learning and action tools for social mobilization	1
5	Tools and techniques of PRA/RRA used in social mobilization process and selection of appropriate tools of participatory learning and action	1
6	Conduct transect walk and night halt in a community and prepare a report	1
7	Conduct Wealth being ranking and Focused group discussion	1
8	Exercise on calculation of HPI, HDI, GDI, GEI based on CBS's current data	1
9	Conduct Resource mapping, Venn diagram and social mapping	1
10	Conduct Priority matrix, problems matrix and direct matrix ranking	1
11	Conduct FGD and prepare Problem tree/ problem solving tree	
12	Conduct stakeholders analysis with response to implement any community development program	1
13	Preparation of Venn diagram and Institution mapping	1
14	Conduct gender analysis by using any gender analysis tools	1
15	Role play and sharing experience (Let's change our gender role for a day)	1
	Total	15

Recommended Reading Materials

1. Chambers, R. (2016). *Revolution in Development Enquiry (Nepal edition)*. Earthscan, New York, US.
2. Khan, S. S. and Sah, J.S. (2001). *Social Mobilization Manual based on Synaja Experiences*. Social Mobilization Experimentation and Learning Center, Nepal.
3. MoLD. (2011). *Village Development Committee: Social Mobilization Guideline 2068*. Ministry of Local Development, Government of Nepal, Kathmandu, Nepal.
4. UNDP. (2001). *Governance and Poverty Reduction*. NHDR, Kathmandu, Nepal.

Soil Science and Agri-Engineering

Agri-Engineering

Course Code	AMT211
Course Title	Agro-Meteorology
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
Upon completing this course, the students will be able to: i. Understand the importance of weather and climate in agricultural production system and relate the growth, development and production of crops to prevailing weather and climate, ii. Understand the meaning of agro-climatic regionalization and make choices of crops and cropping system in the limits of weather and climate, and iii. Understand the importance of climate smart agriculture and means to climate proofing.
Course Description
Definition, role and importance of agro meteorology; Solar Radiation, temperature, humidity, wind movement, precipitation; Crop zonation, soil moisture and micro-climate modification; Basic understanding on elements of weather and climate, their variability and measurements, climatic requirements of different crops; Crop water requirements, agro-climatic regionalization; Weather forecast and agricultural advisory.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Definition, role and importance of agro-meteorology; Scope of agro meteorology	1
2	Concepts of weather and climate; Classification of climate; Climate systems in Nepal; Sources of climatic variation and climate systems in Nepal	1
3	Solar Radiation: Diurnal and annual variations in solar radiation; Radiation balance and net radiation	1
4	Solar radiation and crop interaction: Crop productivity and solar radiation relationship.	1
5	Air and soil temperature: Diurnal and annual variation; Effects of air and soil temperature on crop physiology, growth, development and production	1
6	Atmospheric pressure and wind: Causes of wind movement; Wind speed and direction; Types of wind systems; Significance of wind movement in agriculture	1
7	Humidity: Processes of humidification and dehumidification of atmosphere; Saturation vapor pressure; Dew point; Significance of atmospheric humidity on agriculture	1
8	Precipitation: Forms and types of precipitation; Rainfall and agricultural decision making	1

9	Soil moisture: Soil water balance and ways of soil water loss in the field	1
10	Evaporation and transpiration; Factors affecting evaporation and transpiration	1
11	Agro-meteorological normal of cereals, pulses, oilseeds, horticultural and plantation crops	1
12	Components of automatic weather station; Sensors for measuring agro-meteorological variables and their working principles	1
13	Agro-meteorological Models	1
14	Types of weather forecast and their usefulness in agriculture; Agro-meteorological advisory system in Nepal	1
15	Climate change and its impact on agriculture; Impacts of climate change on crop and livestock production system in Nepal	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of various weather recording instruments in an agro-meteorological station	1
2	Study of the macro and micro-climate and ways to manage micro-climatic variability in the agriculture field	1
3	Introduction to Nepalese Agro-ecology and pocket zones of various agriculture crops	1
4	Measurement of solar radiation – intensity, duration, quality	1
5	Measurement of ambient, maximum and minimum air temperature	1
6	Measurement of soil temperature using various instruments	1
7	Measurement of atmospheric pressure and wind velocity for different height	1
8	Measurement of atmospheric humidity using psychometric chart	1
9	Study and handling of rain gauge and computation of rainfall from recording type rain gauge	1
10	Estimation of missing precipitation data and computation of average precipitation of an area	1
11	Estimation and measurements of evaporation and transpiration	1
12	Visit to nearby Automatic weather station of the Agriculture Campus	1
13	Introduction to various weather related models	1
14	Introduction to various crop simulation models used in agriculture decision making	1
15	Agro-advisory service systems in Nepal and their implications in making agriculture production decisions	1

Recommended Reading Materials

1. Reddi S.R. and Reddi, D.S. (2014). *Agro-meteorology*. Kalyani Publishers, New Delhi.
2. Mote B.M. and Sahu, D. D. (2014). *Principle of Agricultural Meteorology*. Scientific Publishers, New Delhi.

Course Code	AEN311
Course Title	Farm Power and Machinery
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
<p>Upon completion of the course, the students will be able to:</p> <ol style="list-style-type: none"> i. Analyze the mechanics involved in farm machines for intended functions, precision in operation, ease of use and control and human drudgery, ii. Evaluate and compare the performance of farm machines and equipment's and make selection for different scale of operations, and iii. Develop skills on the management, maintenance and upkeep of farm machines and equipment.
Course Description
<p>Source of Farm Power; Objectives and scope of Farm Mechanization; Internal Combustion Engine; Tillage: Primary and secondary tillage implements; Farm machines and equipment, their uses in farm operations, selection and maintenance of farm tools; Seeding and planting machines; Machines and equipment for plant protection; Harvesting and threshing machines; Combined harvesters; Selection and economics of Farm machines and equipment.</p>

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Sources of farm power, availability, advantages and limitations of different farm power sources; Objectives of farm mechanization; Scope and constraints to farm mechanization in Nepal; Policies and related strategies to farm mechanization in Nepal	1
2	Internal Combustion Engine: Types, components and their functions	1
3	Four stroke and Two stroke Engines- Working principle, advantages and disadvantages	1
4	Definition and objectives of tillage: Primary and secondary tillage; Physical, chemical and biological properties of soil influenced by tillage; Changing views and practices of tillage	1
5	Mould Board Plough and Disc Plough- Types, components and working principle, accessories and attachments	1
6	Harrows: Functions of harrows, types, components and working principle of disk harrows; Selection and uses of harrows	1
7	Rotary Tillage tools and implements: Components and working principle of Rotavator; Advantages and limitations of rotary tillage; Specialized tillage implements and tools- Sub-soiler and chisel plough; Ridger and Bund former, Puddler	1
8	Tools and implements for intercultural operations- Objectives of	1

	intercultural operations; Types, construction and working principle of cultivator; Types of intercultural tools: Sweep, shovel, hoe, rotary hoe etc., Horticultural tools	
9	Methods of seeding and planting: Types, construction and working principle of drills and planters; Seed and fertilizer metering devices; Furrow openers and covering devices in drills and planters	1
10	Rice Transplanters: Types and working principle; Recent advances in seeding and planting machines	1
11	Spraying and dusting: Types of sprayers and dusters; Working principle and components of sprayers; Working principle and components of duster; Safety in handling plant protection machines; Selection and calibration of sprayers and dusters	1
12	Crop harvesting methods; Mowers: Types, working principle, functional parameters of mower cutter-bar; Adjustments and balancing of cutter-bar; Reapers and Wind rowers: Types, working principle; Adjustments and performance; Potato Digger: Working principle; Sugarcane harvester: Working principle; Fruit harvesting machinery	1
13	Threshing methods: Types of threshers, their working principles; Factors affecting thresher performance; Adjustments and trouble shooting in mechanical threshers	1
14	Classification and functional components of grain combines; Material flow and adjustments in grain combines; Adjustments and trouble-shooting in combine harvesters	1
15	Field capacity and efficiency; Selection criteria of Farm Machines and Equipment; Cost of operation of Farm Machines- fixed and variable costs	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Study on repair and maintenance tools and different machine elements with their functions	1
2	Identification of components of IC engine	1
3	Study of engine system and their care and maintenance - intake and exhaust system, cooling system, lubricating system, fuel supply system, ignition system	2
4	Study of farm tractor control system and their care and maintenance - clutch, gear box, differential, brake, steering, PTO, hitching, hydraulic system	2
5	Operation of tractor and power tiller	1
6	Field performance evaluation of primary tillage implements	1
7	Field performance evaluation of secondary tillage implements	1
8	Calibration and field adjustments in seed drills and planters	1
9	Field performance evaluation of seeding and planting machines	1
10	Field performance evaluation of plant protection equipment	1
11	Field performance evaluation of harvesters	

12	Field performance evaluation of threshers	1
13	Development of farm machinery procurement and management plan for: a) a commercial farm , b) a custom hiring enterprise	1
	Total	15

Recommended Reading Materials

1. Srivastava A.C. (1991). *Elements of Farm Machines, 1st edition*. Oxford and IBH Publishing Co. Ltd., New Delhi, India.
2. Kepner, R.A., Bainer, R. and Barger, E I. (2005). *Principle of Farm Machinery, 3rd edition*. CBS Publishers and Distributors, New Delhi, India.

Course Code	AEN611
Course Title	Farm Structure and Survey
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course

The main objective of this course is to enable the students to

- (i) prepare and interpret maps/plan, and
- (ii) learn about farmstead planning, and best estimation and construction practices of farm structure.

Course Description

Surveying: definition, classification, units of measurements, scale, chain survey and compass survey; Traversing; Leveling, booking and reducing levels, contour; Construction materials; Components of farm building.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction: Definition of surveying, classification, units of measurement, scale (graphical and shrunk scale)	1
2	Chain survey: Taping, ranging (direct and indirect), chaining on flat and sloping ground	1
3	Chain triangulation	1
4	Compass survey: Introduction, meridians, bearing, interior angles, types of compass, use of prismatic compass, local attraction	1
5	Traversing and plotting traverse	1
6	Leveling: Objective, instruments, temporary adjustment	1
7	Booking and reducing levels (height of instrument and rise fall method)	1
8	Contour (introduction, characteristics); Topographic map and its uses	1
9	Construction Materials: Bricks, cement, sand, gravel, concrete, mortar, RCC, PCC,	1
10	Materials used in the construction of agricultural structures: Timber, steel,	1

	CGI sheet, thatch, centering and shuttering	
11	Components of farm buildings: Foundation, beam and column walls	1
12	Types of floors, roofs, door and windows	1
13	Site selection and planning of farm buildings, thermal insulation and ventilation process and principle in farm buildings	1
14	Planning, layout and functional requirements of the farm structures	1
15	Estimating and costing: Types and estimate (Approximate and detailed), analysis of rate	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Linear measurement by Pacing	1
2	Measurement of distance by Ranging and Chaining.	1
3	Chain Triangulation	1
4	Compass traversing	1
5	Profile leveling and grid leveling for contouring	1
6	Determination of elevation of various points by collimation method and rise and fall method	1
7	L-Section and Cross-Section of the Canal	1
8	Determination of area based on field measurement and map measurement	1
9	Contour plotting by square grid method	1
10	Concept of Drawings	1
11	Dairy Cattle House drawing (Plan, elevation and cross-section)	1
12	Poultry House drawing (Plan, elevation and cross-section)	1
13	Swine House drawing (Plan, elevation and cross-section)	1
14	Estimating Quantity of Materials	1
15	Estimating Cost of Construction	1
	Total	15

Recommended Reading Materials

1. Kumar, S. (2010). *Building Construction*. Standard Publishers Distributors, India.
2. DUDBC. (2007). *Nepal National Building Code (NBC 000: 1994) - Reprint 2064*. Department of Urban Development and Building Construction, Ministry of Physical Planning and Works, Government of Nepal.
3. Michael, A. M. and Ojha, T. P. (1978). *Principles of Agricultural Engineering*. Jain Brothers, India.
4. Punmia, B. C., Jain, A. K and Jain A. K (2016). *Surveying (Volume II) - 16th Edition*. Laxmi Publications (P) Ltd., India.

Course Code	AEN721
Course Title	Principles and Practices of Irrigation
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
The main objectives of this course are to provide basic knowledge and practices on scheduling and estimation of depth of irrigation to meet consumptive use in the cropped field, measure and apply required quantity of water by using different irrigations methods familiar with field drainage methods.
Course Description
Irrigation: introduction and history (Nepal); Water resource potential of Nepal; Soil water retention and movement; Determination of crop water requirement; Consumptive use of water; Irrigation methods and scheduling; Drainage

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction; history of irrigation development in Nepal; Water resource potential for irrigation in Nepal	1
2	Role of irrigation in agriculture; Irrigation practices in Nepal	1
3	Soil-water-plant relationship with respect to irrigation	1
4	Soil water retention and movement: Infiltration, percolation, hydraulic conductivity, permeability, seepage and inflow	1
5	Soil moisture constants with numerical problems and calculations	1
6	Water requirements of crops: Methods of determination of crop water requirement	1
7	Water requirements of crops: Base period, irrigation intensity, command area; Duty of water and Delta	1
8	Water requirements of crops: Numerical problems and calculations	1
9	Consumptive Use: Consumptive use rate; Estimation of consumptive use by direct method	1
10	Consumptive Use: Estimation of consumptive use by empirical method: Modified Penman method, Blaney and Criddle method; Cirstiansen method	1
11	Consumptive Use: Numerical problems and calculations	1
12	Irrigation scheduling: Objectives of irrigation scheduling; Soil moisture extraction pattern and moisture sensitive periods of crops	1
13	Irrigation scheduling: Depth and interval of irrigation; Indicators for irrigation scheduling	1

14	Irrigation scheduling: Numerical problems and calculations	1
15	Farm irrigation practices: Surface irrigation methods and its design	1
16	Farm irrigation practices: Sub-surface irrigation methods and their design	1
17	Farm irrigation practices: Drip and sprinkler irrigation method and their design; Other advanced and high-tech irrigation methods and their design	1
18	Hydroponics: Concept, technology, use and its feasibility	1
19	Efficiencies of irrigation water conveyance and application; Advance irrigation techniques	1
20	Water conveyance and distribution system: Layout of irrigation canals	1
21	Water conveyance and distribution system: Components of channel crossing structures and water control structures	1
22	Water conveyance and distribution system: Erosion control structures	1
23	Farm water measuring methods: Different methods available for measuring farm water	1
24	Farm water measuring methods: Numerical problems and calculations	1
25	Quality of irrigation water	1
26	Irrigation pumps: Centrifugal pumps, turbine pumps, propeller pumps	1
27	Characteristics of different types of pumps	1
28	Irrigation pumps: Numerical problems and calculations	1
29	Field drainage theory and methods: Water logging problem; types of drain	1
30	Methods of drain: Surface and sub-surface methods	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Measurements of soil moisture by using Tensiometer, moisture meter, gravimetric method and feel method	1
2	Determination of soil moisture potentials: Field capacity, permanent wilting point and saturation	1
3	Determination of infiltration capacity by using Double ring infiltrometer	1
4	Assessment to determine irrigation scheduling	1
5	Calculation of consumptive use by using empirical formulas: Modified Penman method and Blanney-Criddle method	1
6	Calculation of consumptive use by using empirical formulas: Blanney-Criddle method	1
7	Estimation of crop water requirement using CROPWAT software	1
8	Field evaluation of surface irrigation methods: Check basin, border strip and furrow	1
9	Assessment of field water losses, seepage, percolation and runoff	1
10	Evaluation of water application efficiencies and water distribution uniformity	1
11	Layout of drip and sub-surface irrigation methods	1
12	Designing of sprinkler irrigation system	1

13	Depth of Irrigation water measurement by using devices: Weir, Parshall-flume and orifices	1
14	Measurement of water flow capacity by using float method and volumetric method	1
15	Field visit to irrigation management project/ program	1
	Total	15

Recommended Reading Materials

1. Manandhar, B.D. (2016). *Laboratory Manual Principles and Practices of Farm Water Management*. Maitreya Agri-Engineering industry, Chitwan, Nepal.
2. Michael, A.M. (2008). *Irrigation Theory and Practices*. Vikash Publication House, New Delhi, India.
3. Modi, P.N. (2000). *Irrigation Water Resources and Water Power Engineering - IV edition*. Standard book house, New Delhi, India.
4. Punmia, B. C. and Pande, B.B. (1990). *Irrigation and water power engineering*. Standard Publisher Distribution, New Delhi, India.
5. Shankara-Reddi, G.N. and Yellamanda-Reddy, T. (1995). *Efficient use of Irrigation water*. Kalyani Publishers, New Delhi, India.

Soil Science

Course Code	SSC121
Course Title	Fundamentals of Soil Science
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course

The main objective of the course is to provide the student about fundamental knowledge and skills within the different areas of soil science to enhance their understanding on relationship between soil and crop production.

Course Description

Soil: Pedological and edaphological concepts; Earth's crust; Composition: Rocks and minerals; Weathering; Components of soils; Soil physical properties: soil texture, textural classes, particle size analysis, soil structure, classification, soil aggregates and their significance, bulk density and particle density of soils and porosity, their significance and manipulation, soil color; Soil Chemical Properties: Soil colloids, properties, nature, types and significance; Layer silicate clays, their genesis and sources of charges, adsorption of ions, ion exchange, CEC and AEC, factors influencing ion exchange and its significance; Soil organisms and their beneficial and harmful roles; Soil Health: Concept of Soil Quality/Health, characteristics of a healthy soil, soil health indicators; Physiographic units of Nepal.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction	
1.1	Definition, concepts and functions of soil	1
1.2	History of soil science	1
1.3	Approaches of soil science	1
1.4	Composition of soil	1
1.5	Branches of soil science, the soil profile and its layers	1
2	Physical Properties of Soil	
2.1	Soil Texture: Definition, methods of textural analysis, Stoke's law- assumption and limitations, soil textural classes	1
2.2	Soil Structure: Definition, classification, genesis of soil structure, management of soil structure	1
2.3	Bulk density, particle density and porosity	1
2.4	Soil Consistency, Attenberg's constant	1
2.5	Soil Color	1
2.6	Soil Aeration	1
3	Chemical Properties of Soil	
3.1	Soil pH and nutrient availability	1
3.2	Acidic soils- pools, causes and management	1
3.3	Saline soils- causes and management	1
3.4	Sodic soils and saline-sodic soils- causes and management	1
3.5	Buffering capacity of soil and liming	1
3.6	Soil colloids and its properties	1
3.7	Types of soil colloids	1
3.8	Layer silicate clays, their genesis and sources of charges	1
3.9	Ion Exchange phenomenon, AEC	1
3.10	Cation Exchange Capacity	1
4	Soil Biology	
4.1	Soil Organism and their Classification	1
4.2	Beneficial and Harmful Role of Soil Organisms	1
5	Soil Health and Quality	
5.1	Concept of soil quality/Health	1
5.2	Characteristics of a healthy soil	1
5.3	Soil health indicators	1
6	Rocks and Minerals	
6.1	Evolution and composition of earth	1
6.2	Rocks	1
6.3	Minerals	1
6.4	Weathering of rocks and minerals	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Precautions to be taken while working in soil science laboratory	1
2	Identification and function of soil science laboratory equipment	1
3	Collection and preparation of soil sample from crop field	1
4	Collection and preparation of soil sample from orchard	1
5	Soil textural determination by Feel method	1
6	Determination of soil consistency	1
7	Particle size analysis by Hydrometer method	1
8	Determination of soil structure	1
9	Soil color determination	1
10	Determination of bulk density of soil	1
11	Determination of particle density of soil	1
12	Determination of pH of soil	1
13	Identification of soil forming rocks	1
14	Identification of soil forming minerals	1
15	Study of soil as a natural body	1
	Total	15

Recommended Reading Materials

1. Biswas, T. D. and Mukherjee, S. K. (1987). *Text Book of Soil Science*. Tata McGraw Hill Publishing Co., New Delhi.
2. Brady, N. C. and Weil, R. R. (2012). *Nature and Properties of Soils (14th Edition)*. Macmillan Publishing Co. Inc., New York
3. Das, D. K. (1997). *Introductory Soil Science*. Kalyani Publishers, New Delhi.
4. Gupta, P. K. (2007). *Soil, Plant, Water and Fertilizer Analysis*. AGROBIOS, Jodhpur, India.
5. Foth, H. D. (1990). *Fundamental of Soil Science (8th Edition)*. Wiley Eastern Pvt. Ltd., New Delhi, India.
6. Jaiswal, P. C. (2006). *Soil, Plant and Water Analysis (2nd Edition)*. Kalyani Publishers, Ludhiana
7. KC, T. B. (1991). *Introduction to Soils and Soil Fertility*. Institute of Agriculture and Animal Science, Chitwan, Nepal.

Course Code	SSC221
Course Title	Manure, Fertilizer and Nutrient Management
Credit Hours	3 (2+1)
Full Marks	75
Theory (Marks)	50
Practical (Marks)	25

Objective (s) of the Course
Upon completion of this course, students will be able to understand functions of plant nutrients, concept of soil fertility, and the role of fertilizers, manures, and bio fertilizers to the plants and

soils.
Course Description
History of soil fertility and plant nutrition; Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, source, functions, deficiency symptoms and availability of plant nutrients; Chemical fertilizers – source, composition, use and behavior in soil; Bio-fertilizers and their uses; Preparation of manures, green manures and vermi-composting; Biogas plant slurry; Method of soil fertility evaluation, integrated nutrient management, soil fertility problems in Nepal; Soil management for sustainable agricultural development.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Historical perspective of soil fertility and plant nutrition	1
2	Criteria for nutrient essentiality; Classification of the plant nutrients	1
3	Nutrient mobility in plants and soil, and its importance	1
4	Functions, deficiency symptoms, and management of Nitrogen and Phosphorus	1
5	Functions, deficiency symptoms, and management of Potassium and Calcium	1
6	Functions, deficiency symptoms, and management of Magnesium and Sulfur	1
7	Functions, deficiency symptoms, and management of Iron, Manganese, Zinc and Copper	1
8	Functions, deficiency symptoms, and management of Boron, Molybdenum, Nickel, Cobalt and Silicon	1
9	Toxicity symptoms of nutrients and their management	1
10	Concept of fertilizers, classification of fertilizers	1
11	Nitrogen fertilizers: Source, composition, uses and behavior in soil.	1
12	Phosphatic fertilizers: Source, composition, uses and behavior in soil	1
13	Potassic fertilizers: Source, composition, uses and behavior in soil	1
14	Concept of organic matter, sources of organic matter	1
15	Composition and decomposition processes of organic matter	1
16	C:N ratio and its significance	1
17	Organic matter and its effect on soil properties	1
18	Roles of bio-fertilizers in soil fertility: Rhizobium, Mycorrhizae, Azotobacter, Azolla and Vermicompost	1
19	Importance of human manure and urine, green manure and bio-slurry	1
20	Different approaches for soil fertility evaluation: Visual diagnosis and plant analysis	1
21	Different approaches for soil fertility evaluation: Biological methods	1
22	Different approaches for soil fertility evaluation: Soil Testing	1
23	Interpretation of the soil testing results	1
24	Factors influencing nutrient use efficiency (NUE) in respect of nitrogen and phosphorus	1
25	Factors influencing nutrient use efficiency (NUE) in respect of potassium and zinc	1
26	Source, method and scheduling of nutrients for different soils and crops	1

	grown under rainfed and irrigated conditions	
27	Soil fertility problems with respect to Nepalese agricultural system	1
28	Concept and approaches of soil management for sustainable agriculture	1
29	Integrated Nutrient Management (INM): Concept and components	1
30	Relevance of INM in context of Nepal	1
	Total	30

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Identification of function of equipment used in soil fertility laboratory	1
2	Soil sampling for soil fertility analysis- from crop field	1
3	Soil sampling for soil fertility analysis- from orchard	1
4	Preparation of soil samples for soil fertility analysis	1
5	Soil testing kit method for N, P, K and pH estimation	1
6	Chemical calculation and preparation of standard solution	1
7	Determination of organic matter content of soil	1
8	Determination of total N in soil (Digestion, distillation and titration)	2
9	Determination of available P in soil	1
10	Determination of available K in soil (Digestion and Flame photometer reading)	2
11	Plant sampling and its preparation for nutrient analysis	1
12	Collection and identification of nutrient deficiency symptoms on major agronomical crops	1
13	Collection and identification of nutrient deficiency symptoms on major horticultural crops	1
	Total	15

Recommended Reading Materials

1. Brady, N. C. and Weil, R. R. (2012). *Nature and Properties of Soils (14th Edition)*. Macmillian Publishing Co. Inc., New York
2. Gupta, P. K. (2007). *Soil, Plant, Water and Fertilizer Analysis*. AGROBIOS, Jodhpur, India.
3. KC, T. B. (1991). *Introduction to Soils and Soil Fertility*. Institute of Agriculture and Animal Science, Chitwan, Nepal.
4. Mengel, K. and Kirkby, E. A. (1982). *Principles of Plant Nutrition*. International Potash Institute, Switzerland.
5. Roy, R. N. (2006). *Plant Nutrition for Food Security: a Guide for Integrated Nutrient Management (INM)*. Food and Agriculture Organization, United Nations.
6. Basak, R. K. (2004). *A Text Book on Fertilizers*. Kalyani Publishers, New Delhi.
7. Tisdale, S. L., Nelson, W. L., Beaton J. D. and Havlin, J. L. (1993). *Soil Fertility and Fertilizers (5th Edition)*. Macmillian Publishing Co. Inc., New York.

Course Code	SSC411
Course Title	Soil Physics, Genesis and Classification
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
To impart basic knowledge about soil physical properties and processes in relation to plant growth especially soil water, soil formation factors and processes, and use of diagnostic soil characteristics to develop classification of soils.
Course Description
Scope of soil physics and its relation with other branches of soil science; Soil as a three phase system; Quantitative concept of soil physics; Soil water: Soil-water constants, energy state of soil water, soil water potential, soil moisture characteristic curve; Water flow in saturated and unsaturated soils, Darcy's law; Hydraulic conductivity; Infiltration mechanism in soil; Soil forming factors and processes, soil moisture and temperature regimes, macro and micro morphological properties of soils; USDA and FAO soil classification system, Kinds and distribution of soils in Nepal and potential uses.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Introduction: Definition, scope of soil physics and its relation with other branches of soil science; Soil as a three phase system	1
2	Properties of soil water, importance of soil water	1
3	Energy concept of water; Soil water potential: Gravitational, Matric and Osmotic potential	1
4	Soil moisture characteristics curve, hysteresis and air entry suction, soil water constants	1
5	Hydraulic gradient, water flow in saturated and unsaturated soils	1
6	Infiltration mechanism in soil, mechanisms of surface sealing and crusting, and their management	1
7	Thermal properties of soil, heat movement in soils, soil temperature in relation to plant growth; Soil temperature management	1
8	Soil forming factors and processes and master horizons	1
9	Characteristics of diagnostic surface horizons	1
10	Characteristics of diagnostic sub-surface horizons	1
11	Soil moisture and temperature regimes: Definition, classification, significance	1
12	Basis for classification of soils according to USDA system; Features of Alfisols, Andisols, Aridisols, Entisols, Gelisols, Histosols	1

13	Features of Inceptisols, Mollisols, Oxisols, Spodosols, Ultisols, Vertisols	1
14	Soil Classification according to FAO system	1
15	Kinds and distribution of soils in Nepal and potential uses	1
	Total	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Volume and mass relation of soil constituents	1
2	Determination of soil wetness by gravimetric method and soil depth	1
3	Determination of water content of soil by resistance	1
4	Measurement of soil water potential by Tensiometer	1
5	Observation of capillary process of soil	1
6	Study of the hysteresis effect	2
7	Determination of field capacity in field and by pot method	1
8	Identification of diagnostic horizons of soil	1
9	Soil profile observation and naming of soil horizons: Lowland	2
10	Soil profile observation and naming of soil horizons: Upland	2
11	Classification of soil and report presentation	2
	Total	15

Recommended Reading Materials

1. Baver, L. D., Gardner, W.H. and Gardner, W.R. (1972). *Soil Physics*. John Wiley and Sons.
2. Brady, N. C. and Weil, N.R. (2012). *Nature and Properties of Soils (14th Edition)*. Macmillan Publishing Co. Inc., New York.
3. Buol, E. W., Hole, E. D., MacCracken, R. J. and Southard, R. J. (1997). *Soil Genesis and Classification (4th Edition)*. Iowa State University Publication/Ames.
4. Hillel, D. (1980). *Fundamentals of Soil Physics*. Academic Press, Inc. New York.
5. Shegal, J. (1996). *Concept and Application of Pedology*. Kalyani Publishers. New Delhi.
6. Lal, R. and Shukla, M. K. (2004). *Principles of Soil Physics*. Marcel Dekker and Sons.

Course Code	SSC520
Course Title	Soil Conservation and Watershed Management
Credit Hours	2 (2+0)
Full Marks	50
Theory (Marks)	50
Practical (Marks)	00

Objective (s) of the Course
Upon completion of this course, students will understand various types of soil erosion and land degradation and mechanisms involved there in, and measures to be taken for controlling soil

erosion to conserve soil and water.

Course Description

Introduction: Importance of soil conservation, soil erosion: causes of soil erosion; Mechanics of soil erosion by water: Definition, types of water erosion; Sediments movement in channels, factors affecting water erosion, wind erosion: Definition and processes; Landslides and Mass wasting; Estimation and monitoring of soil loss, soil erosion control and control measures; Land capability classification of soil, conservation measures, bio-engineering techniques; Concept of watershed management and soil conservation planning; Present status of soil conservation and watershed management in Nepal.

Course Breakdown (Theory)

SN	Course Outline	Lectures
1	Introduction to soil conservation: Erosion, population and food supply	1
2	Definition and types of soil erosion	1
3	Causes of soil erosion	1
4	Consequences of soil erosion.	1
5	Desertification: Causes and processes in Nepal	1
6	Types of water erosion	1
7	Sediments movement in channels	1
8	Factors affecting water erosion	1
9	Landslides and mass wasting: Causes and control measures	1
10	Soil erosion by wind: Mechanics of wind erosion	1
11	Types and factors affecting wind erosion	1
12	Soil erosion monitoring and estimation: Simple visual methods	1
13	Runoff plot monitoring and sedimentation survey	1
14	Empirical methods for soil loss estimation: Rainfall factor	1
15	Erodibility factor and length or slope length factor	1
16	Slope gradient factor, crop management factor and conservation practice factor	1
17	Land Use Capability Classification (LCC) of soil	1
18	Importance of LCC	1
19	Soil conservation: Definition and approaches	1
20	Agronomical approaches of soil conservation: Mulching, Liming, fertilizing, green manuring and organic manuring, cover crops, soil depleting, soil conserving and soil building crops	1
21	Soil management: Organic matter content, tillage practices, farm drainage	1
22	Mechanical soil conservation: Terracing	1
23	Soil conservation practices on farm land, pastures, forests and urban areas	1
24	Sloping Agricultural Land Technology (SALT)	1
25	Bioengineering Techniques: Introduction and functions of bio-engineering measures	1
26	Comparison of bio-engineering with conventional approaches	1
27	Concept, objectives and watershed characteristics	1
28	Causes of watershed degradation	1
29	Watershed management planning and integrated watershed management;	1

	Water harvesting techniques	
30	Present status of soil conservation and watershed management in Nepal	1
	Total	30

Recommended Reading Materials

1. Bennett, H. H. (2014). *Elements of Soil Conservation (2nd ed.)*. McGraw-Hill Book Company. New York.
2. Brook, K. N., Flolliott, P. F., Gregersen, H. M. and Thames, J. L. (1991). *Hydrology and the Management of Watershed*. Iowa University Press, USA.
3. FAO. (1997). *Guidelines for Watershed Management*. FAO. Field Manual.
4. Kumar, M. (2012). *Crop Management and Soil Conservation*. Pragun Publications.
5. Murty, V. V. N. (1985). *Land and Water Management Engineering*. Kalyani Publishers, New Delhi.
6. Shukla, A. K., Khatri-Chetri, T. B and Pandit, K. N. (1991). *Laboratory Manual of Soil and Water conservation*. Institute of Agriculture and Animal Science, Chitwan, Nepal.
7. Tripathi, R. P. and Singh, H.P. (1993). *Soil Erosion and Conservation*. Wiley Eastern Ltd. New Delhi.
8. Wani, S. P., Rockstrom, J. and Sahrawat, K.L. (2011). *Integrated Watershed Management in Rainfed Agriculture*. CRC Press, New York.

Course Code	SSC711
Course Title	Geo-Informatics and Nanotechnology for Precision Farming
Credit Hours	2 (1+1)
Full Marks	50
Theory (Marks)	25
Practical (Marks)	25

Objective (s) of the Course
The objective of this course is to provide theory as well as hand-on skill to students for various applications in Remote-Sensing (RS), GIS and related technology for precision agriculture.
Course Description
Precision agriculture Geo-informatics, GPS, GIS, System simulation, Remote sensing, Nanotechnology.

Course Breakdown (Theory)		
SN	Course Outline	Lectures
1	Precision agriculture: Concepts and techniques, various tools of precision agriculture used in abroad and Nepal	1
2	Common issues and concerns of precision agriculture in Nepalese agriculture	1
3	Geo-informatics: Definition, concepts, tool and techniques; their use in Precision Agriculture	1
4	Common issues and concerns of geo-informatics in Nepalese agriculture	1
5	Crop discrimination, yield monitoring and forecasting, soil mapping,	1

	fertilizer recommendation using geospatial technologies	
6	Spatial data and their management in GIS	1
7	Geodesy and its basic principles	1
8	Remote sensing concepts and application in agriculture; Image processing and interpretation	1
9	Global positioning system (GPS), components and its functions	1
10	System Simulation: Concepts and principles, introduction to crop Simulation Models and their uses for optimization of agricultural inputs	1
11	Crop cutting: Scope, methodology and importance in forecasting crop yield	1
12	STCR approach for precision agriculture	1
13	Nanotechnology, definition, concepts and techniques	1
14	Brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors	1
15	Use of nano-technology in tillage, seed, water, fertilizer, plant protection for scaling-up farm productivity	1
	TOTAL	15

Course Breakdown (Practical)		
SN	Course Outline	Lectures
1	Introduction to GIS software, spatial data creation and editing	1
2	Introduction to image processing software	1
3	Visual and digital interpretation of remote sensing images	1
4	Generation of spectral profiles of different objects	1
5	Supervised and unsupervised classification and acreage estimation	1
6	Multispectral remote sensing for soil mapping	1
7	Creation of thematic layers of soil fertility based on GIS	1
8	Creation of productivity and management zones	1
9	Fertilizer recommendations based of VRT and STCR techniques	1
10	Crop stress (biotic/abiotic) monitoring using geospatial technology	1
11	Use of GPS for agricultural survey	1
12	Crop cut survey and its application in estimation of cereal yields	1
13	Crop simulation modeling in applying agricultural decision making	1
14	Formulation, characterization and applications of nanoparticles in agriculture	1
15	Project formulation and execution related to precision farming	1
	TOTAL	15

Recommended Reading Materials

1. Asrar, G. (1989). *Theory and Application of Optical Remote Sensing*. John Wiley and Sons, New York.
2. Lillisand, T. M., Kiefer, R. W and Chipman, A. (2004). *Remote Sensing and Image Interpretation (5th edition)*. John Wiley and Sons, New York.
3. Steven, M. D. and Clark, J. A. (1991). *Application of Remote Sensing in Agriculture*. Butterworths, London.

Agricultural Enterprise Development

Course Code	AED501 / AED601 / AED701
Course Title	Agri-Enterprise Learning and Development
Credit Hours	0+1
Full Marks	25
Theory (Marks)	00
Practical (Marks)	25

Objective (s) of the Course

Upon completion of this course, students will be able to thoroughly understand the practical aspect of crop and animal husbandry by directly engaging in the commercial production of selected crop and livestock enterprises. This will not only help them learn the biological processes of crop and livestock production, but also help them learn the monetary expenses involved as well as possible profits from these enterprises. This will, ultimately, encourage students for entrepreneurship development by taking up crop/ livestock enterprises after their graduation.

Execution Modality

Each student of 5th, 6th and 7th semester is required to engage in the direct production of selected agronomical crops, horticultural crops and livestock animals (including aquaculture) under the activities of Agri-Enterprise Learning and Development. However, in each semester, a student will be engaged in any one enterprise only and the remaining two enterprises will be taken up in the next semesters. So, in each semester only around one-third of the students are allowed to take up enterprises related to (i) agronomical crops, (ii) horticultural crops or (iii) livestock animals, including fish. Thus, by the end of 7th semester all students shall have been engaged in the production of selected agronomical and horticultural crops as well as selected livestock animals (or fish).

For taking up each of these enterprises, students will be divided into several groups of 5-10 students. Each group of students will be provided a certain amount of revolving fund to take up the enterprise offered by three divisions/units (i) Agronomy, (ii) Horticulture and (iii) Animal Science and Aquaculture. The original amount of funds spent in the project needs to be returned to faculty after completion of the project as a seed money. The enterprise to be taken up will be offered by respective divisions/units. Under the guidance of designated faculty member, the students will carry out day-to-day activities to successfully grow the selected crops or raise the selected livestock animals/fishes. The students will also record all the financial transactions done throughout this period. The profits from these activities will be equally shared between the students. In case of losses, students should formally write to the designated authority explaining in detail about the reason for losses, approved by the designated faculty member. A team will be prepared to investigate such cases and upon its recommendation such losses could be exempted for paying back.

Research, Practices and Seminar

Course Code	RPS813
Course Title	Research, Practices and Seminar
Credit Hours	1+3
Full Marks	100
Theory (Marks)	25
Practical (Marks)	75

Objective (s) of the Course

To make students capable to prepare simple project proposals, implement such projects in the field exactly as outlined in the proposal, understands the real-world situation of farmers and/or practical issues that may arise in the course of their work/job after their graduation, collect necessary data as prescribed in the proposal, analyze these data and prepare a report in the form of research paper and present the process along with the results in the public forum (e.g. seminar/conference) and publish it in the form of research article/ **mini-thesis**.

Execution Modality

1. The agricultural graduates should be well acquainted and equipped with the entrepreneurial skills to transform the Nepalese agriculture as per the policies, plans and programs of the Government of Nepal (GoN). Also, they should be independently equipped with technical skills to prepare project proposals, undertake research projects and prepare reports based on it.
2. Entrepreneurial learning is a complex issue in agricultural education system that often reflects the distinctive dispositions of entrepreneurs. Considering the urgency given to this aspect in the recent years at different national and international forum, the undergraduate students of B. Sc. Ag. will be enrolled in Research, Practices and Seminar (RPS) program during the entire duration of final (8th) semester.
3. The broad objective of the RPS program is to make the students able to design agricultural project for maximizing the productivity and profitability of agriculture.
4. The specific objectives of the RPS program are as follows:
 - To enable students to develop the agriculture enterprise.
 - To make them able to execute the project activities in the field.
 - To strengthen students to interact with commercial farmers and other stakeholders regarding farmers' problem and conduct survey research / action research / case study on those issue.
 - To make them able to prepare scientific and technical document (s).
5. All under graduate students of B. Sc. Ag. must participate in RPS program either at the farm of Faculty of Agriculture (FoA) or at any other appropriate location selected by FoA for a 6-months duration under Plan-A or Plan-B [Annex I(a) and Annex I(b)] **or any other plans that FoA may implement in that particular year.**

6. The FoA will have a permanent type of “RPS Student Selection Committee/RPS-SSC”, which will foresee the activities related to conduction of RPS, including making changes in the RPS conduction guidelines as per the changing context and send it to higher authorities for approval.
7. The FoA will announce well ahead in advance about the RPS opportunities available, upon recommendation of RPS-SSC, at different Divisions (Annex II).
8. Based on this announcement, students must fill up the form showing their interest to be a part of RPS under different plans in different Divisions (Annex III). Students must select (preference ranking) at least 3-5 different combinations of prioritized subjects/ divisions and plans.
9. FoA will then select students based on available quota under different Plans/Divisions. If there are more number of applications then the available quota, the FoA will prioritize students with higher grade marks. Higher the grades/marks, students are prioritized to choose their RPS Divisions/Plans. The list of students selected under different Divisions/Subjects/Plans will then be sent to respective Divisions.
10. Thereafter, the students must consult with respective divisional heads (Instruction Committee Chair/ICC) to prepare “Technical Project Proposals/TPP” to be submitted to the Proposal Supervisory Committee/PSC, headed by ICC with membership of all faculty members under that Division.
11. The PSC will allot one individual “Major Supervisor” and one “Member Supervisor” to each student for conducting its activities. For RPS under Plan-B, the representative of Supporting Organization will also act as the “Site Supervisor”. The student will have the choice of variety of research: Action Research, Field-based Research, Survey Research, Review Research, Policy Research, Case Study Analysis, etc., which will be determined with discussion between student and supervisor.
12. The Major Supervisor will have deciding authority in case of student research, etc. The duties and responsibilities of all supervisors is to guide and provide proper support for preparation of different reports and presentation materials, complying with the guidelines set by FoA. They should also guide collection of data from the field, from time to time. They should also review TPP, mid-term progress report (MPR) and Mini-Thesis (Research Article) before final submission to FoA and provide feedback for improvement, if needed.
13. Based on consultation with the supervisors, the student will prepare the TPP (sample on Annex IV) and defend it in front of PSC. The topic must be selected based on Strategic Priorities of FoA and Far-Western University. The topic may be related with Action Research, Field Research, Survey Research, Case Studies, etc.
14. Wherever applicable students can also work in group (2 or more students) under same or different projects as per the availability of the departmental resources. Grouping will be usually based on same commodity (e.g. Rice, Wheat, Maize, Cauliflower, Poultry, Cow, Fish, etc.) but students may have research in different aspects (e.g. yield, color, aroma/flavor, disease, pest, by-product yield, physical performance, weight, height, etc.).
15. After the approval from PSC, the students should immediately start working on the project either inside or outside the FoA. As per the methodology proposed in the TPP, students should follow the same/ exact procedure, collect required data throughout the project period. The progress in each step should be reported to the Supervisor regularly.

16. MPR should be presented to the PSC in the timeline indicated in the TPP or within 2-3 months of project initiation through online medium (e.g. Skype, ZOOM, MS-Team etc.).
17. After completion of project, the student should analyze the collected data and prepare a technical report, which will be a sort of Mini-Thesis (sample in Annex V). This report should be submitted before the semester-end in the prescribed format (Annex VI). If the student is unable to submit the Mini-Thesis by this deadline her/his result may be delayed which will be approved in the next year.
18. The students should defend/present their findings in the seminar organized by FoA. Students must also be able to publish it as a Research Article in the official publication of FoA.
19. Evaluation of RPS will be carried out by the PSC (Annex VIII). The external examiner can be invited in case of students doing RPS under “Plan B”.
20. In certain case, if the results are negative or the crops or animals are damaged due to uncontrolled environmental calamities beyond the capacity of student, decision on the grade would be made by the PSC based on field records, collected data forms, photos, etc. The PSC may also opt for carrying out some Review Research doable in the time period remaining.

Module I: Research Methodology and Technical Writing (1+0)

Course Breakdown (Theory)		
S.N.	Topics	LH
1	Introduction to research typology and Research proposal/ PCN/ Synopsis	1
2	Proposal writing in socio-economic and bio-physical science based research	1
3	Literature review and drawing epilogue for the further research in socio-economic and bio-physical science research	
4	Research methodology to be followed for socio-economic and bio-physical science based research	1
5	Collection of data through proper sampling techniques for socio-economic research (primary and secondary sources)	1
6	Collection of data from on-station/ on-farm trials in bio-physical science research	1
7	Data management and tabulation in Excel sheet and refining the data sources	1
8	Data analysis with some inferential and descriptive statistical tools like percentile, mean, standard deviation, co-relations and regression, probability, X ² test, t-test, Z-test, ANOVA etc.	1
9	Analysis and interpretation of data by tables and figures using Standard error bar-diagram	1
10	Study on various statistical tools used on socio-economic research (SPSS/ STRATA etc.) and bio-physical science research (MSTAT-C/ Gen-Stat/ Mini-Tab/ R-Studio etc.)	1
11	Teaching the basics of Technical writing: Proceedings/ Research articles/ Research reports/ Mini-thesis	1
12	Ways of writing Table and Figure Headings and their presentation in the research article	1
13	Referencing styles (APA/ MLA formatting)	1
14	Conduction of Workshop/ Conference/ Seminar/ Symposium etc. on the	1

	individual research	
15	Formatting and style guidelines to prepare a Mini-thesis/ Research report	1
15	Certification and final Mini-thesis/ Research report preparation and submission to the Department	1
Total		15

Module II:

Preparation of Research Proposal (0+1)

Students should prepare a research proposal and successfully defend it before PSC seminar to the actual implementation of his/her research. The project should also be carried out exactly based on this proposal and for any deviation prior approval is mandatory.

Module III: Field Survey / Field Experiment (0+1)

Based on the approved research proposal, students must conduct his/her field experiments and or field survey. In this process s/he should record all necessary information based on agreed protocol to be able to write research article later on based on his/her experiment/survey.

Module IV: Technical Writing and Presentation (0+1)

Students must arrange the collected data, analyze it and draw inferences from his/her findings. This should all be arranged neatly in a technical paper, which needs to be published in the official publication of the FoA. If students are able to publish in other peer reviewed journal inside/outside Nepal, it will also be considered equivalent to the FoA's publication. However, student must present his/her findings in front of the public form (seminar, conference, symposium etc.) organized by the FoA for dissemination of students' research.

Timeline for Conduction of "Research, Practices and Seminar"

Unless otherwise specified by the respective authorities, the tentative timeline for accomplishing the different activities under different modules will be as follows (this should be announced by the implementing authority separately for specific batch of the students):

Module I: Throughout the Semester

Module II: Up to One month after the start of Semester

Module III: Up to Three-Four months after the start of Semester

Module IV: (a) Technical Writing - Up to Six months after the start of Semester

(b) Presentation -Up to Six months after the start of Semester

Annexes

Annex I(a): Detail description and process of enrolling and completion of RPS in “Plan A”

Plan A: RPS program will be conducted at FoA farm (on-station) or nearby locations in group approach under following terms and conditions:

- Student (s) need to prepare and present Technical Project Proposal (Annex V) to the Project Supervising Committee (PSC) within 1 months.
- The PSC will examine the proposal, send it for revision(s) and accept it, if deemed appropriate.
- The nominal funding required to carry out the field activities under the project will be managed by FoA, after the approval of PSC.
- Student(s) need to carry out all the field activities, exactly as mentioned in the project proposal.
- PSC will review the project progress, monitor the activities at field and may require progress reporting.
- The data collection and recording of each steps will be carried out by the students.
- After the project ends, PSC will review the business performance, profit/loss along with the technical performance of the project.
- Student(s) can sell the produce, if any, and must return the seed money at the end of the project, otherwise the result will be withheld for the particular student/ group of the students.
- RPS under Plan-A will be called Entrepreneur Group Modality (EGM).

Annex I(b): Detail description and process of enrolling and completion of RPS in “Plan B”

Plan B: RPS program will be performed at out-station in the appropriate location and industry in an individual or group approach upon availability of external funding (funding sources from outside of FoA) under following terms and conditions:

- A MoA (Memorandum of Agreement) will be conducted with the supporting organization in advance for the internship of the students and the terms and conditions mentioned therein will prevail in case of students, including any financial support. The MoA will also clarify the possible locations, research themes, development activities, industrial division, etc. where the student will work and other such information in detail.
- Student (s) need to prepare and present Technical Project Proposal (Annex V) to the Project Supervising Committee (PSC) within 1 months.
- The PSC and the representative from supporting organization will examine the proposal, send it for revision (s) and accept it, if deemed appropriate.
- The funding required to carry out the field activities under the project will be managed by the supporting organization.
- After approval, the students will be deputed to the designated site of the supporting organization as per the MoA.
- Student (s) need to carry out all the field activities, exactly as mentioned in the project proposal in close coordination with the representative of the supporting organization.
- The representative of the supporting organization as well as the PSC will review the project progress and may require progress reporting. However, the representative of the supporting organization will monitor the field level activities, with or without PSC.
- The data collection and recording of each steps will be carried out by the students in close supervision of the representative of supporting organization.
- After the project ends, PSC will review the technical performance of the project conducted by the students.

Annex II: Sample Template for RPS Quota Announcement for different Divisions

Division	Subject	Plan A	Plan B
Agronomy and Plant Breeding	Agronomy (Crop Management, Seed Science, Weed Science)		
	Genetics and Plant Breeding		
Animal Science and Aquaculture	Animal Science (LPM, ANU, ANB)		
	Aquaculture		
Basic Science	Basic Science (Bio-Chemistry, Crop Physiology, Micro-biology, Env. Science)		
Horticulture and Agro-forestry	Horticulture (Pomology, Olericulture, Floriculture)		
	Agro-forestry		
Plant Protection	Entomology		
	Plant Pathology		
Social Science	Agricultural Economics and Agri-business Management		
	Agricultural Extension and Rural Sociology)		
Soil Science and Agricultural Engineering	Soil Science		
	Agricultural Engineering		

Annex III: Sample Template for RPS Form to be filled by the Students

Name of the Student:

Grade Point Average (averaged till 6th Semester):

Priority Ranking (not more than three)

Division (Subject)	Plan Type
1.	
2.	
3.	

I certify that the above information is correct and I will abide by the decision made by concerned authority for RPS program.

Signature of the Student

Verified (HoD)

Annex IV: Sample Template for Technical Project Proposal (TPP) and Preparation Guidelines

A. COVER PAGES

Front Cover Page

- Title of the Research Proposal
- Submitted to
- Submitted by information
- Month and Year of Submission

Contents

- Should include the main headings and sub-headings, with page references

List of Tables

- Should include the list of all tables (except in the Annex), with page references

List of Figures

- Should include the list of all figures (except in the Annex), with page references

Abbreviations

- Should include all the short forms used inside the text with appropriate full forms

Executive Summary

(Maximum 1-2 pages)

- Provide the summary of whole proposal in concise manner

B. MAIN TEXT

Chapter 1. Introduction

1.1. Background information

- Provide background information leading to your research
- Setting the context of your research
- Contains facts, trends, point of views, opinions, etc. as drawn from previous literature, etc.

1.2. Problem Statement

- Logical lead into the problem you are trying to solve based on ground realities, real world problem of farmers, or other such research problems

1.3. Rationale and Justification

- Provide justification for the need of research you are going to conduct
- Explain the significance of this study that also explains the groups that could potentially benefit from this study and the reason they will get benefitted

1.4. Research Questions

- Describe the problems that you are trying to solve through your research
- If you are doing a Case Study, try to explore and describe the issue rather than making any inferences (i.e. explorative and descriptive research)
- In other research, try to make inferences so that you can present what questions do you answered

1.5. Overall Objective

- Based on research question(s) explain the purpose of your research

1.6. Specific Objectives

- You can break down the purpose of your research into more than one objectives based on individual research questions (as above)

1.7. Limitation of the Study

- If your research is not exhaustive and covers everything that should be covered under ideal conditions, explain the things that you missed or could not cover or is beyond the scope of your research
- Also discuss if there are any assumption made by you

Chapter 2. Literature Review, Site and Trend Analysis

Literature review for the selected topic should be done in this section. At least 10-15 references published will be cited that will be the base on student's research. Out of these 3 literatures must correspond directly with the research being undertaken by the student. Priority should be given to research conducted in the locality selected by the student and reports, etc. of local level organizations should also be consulted.

The student must also present demographic, soil, socio-economic, geographic, climatic, and other such information about the selected site, wherever applicable.

If trend analysis is to be done on area, production, productivity, demand, price trend analysis, etc. will be done with reference to last 5 years data (from the year of availability).

For aligning research with GoN policies, plans and programs students should review and cite the relevant secondary information **from**: Agriculture related central and provincial Ministries and Department; Central Bureau of Statistics; Agriculture Development Strategy (ADS: 2015-2035); Agriculture related local level (Municipality/Rural Municipality) organizations or Departments; GoN projects like Prime Minister Agriculture Modernization Project (PMAMP), etc.

Along with this section, in the Annex, following table should also be prepared to write the summary of the literature review work.

Table. Epilogue drawn from the literature review work done

Reference Literature	Year of the study	Country and site of the study	Methodology used	Key findings	Remarks

Chapter 3. Conceptual Framework, Hypothesis and Models

Student should prepare the conceptual research framework for her/his research based on the objectives, literature review, site and trend analysis.

Chapter 4. Methodology

- Research instruments/design
 - For field and action research: treatment-control design
 - For survey research and case study: Household Survey, Rapid Market Appraisal, Focus Group Discussion (FGD), Key Informant Interview (KII), Field Observation and Verification, etc.
- Research instrument/design theme might be: inputs (e.g. supply chain of seeds and materials), production (with farmers), market and marketing (with concerned traders), value chain analysis (enabling business environment, market chain and inputs/service provision), etc.
- Students will prepare the detail instruments/design for the research based on specific, rational and identified problem(s).
 - Sample and sampling technique
 - Data and data types
 - Data analysis techniques

Chapter 5. Expected outputs

What the student expects by completing her/his research? What are the outputs/outcomes of the research? What new contribution will be made? What findings are expected?

Chapter 6. References

Enlist all journal articles, books, and other literature reviewed and quoted in the main text in the appropriate format in APA style (Annex VII).

Chapter 7. Annex

Enlist all other tables, figures, maps of research site, treatment-control design, survey questionnaire, checklists for KII, and case studies, etc. (separately in different Annexes) in this section.

Annex V: Sample Template for Technical Writing (Mini-Thesis / Research Article)

A. COVER PAGES

Front Cover Page (Title Sheet)

- Title of the Research
- Submitted to
- Submitted by information
- Month and Year of Submission

Certificate

- Certificate from the PSC
- Certificate from Supervisor

Acknowledgement

- Acknowledge contributions of all concerned, including financial sponsors (if any)

Contents

- Should include the main headings and sub-headings, with page references

List of Tables

- Should include the list of all tables (except in the Annex), with page references

List of Figures

- Should include the list of all figures (except in the Annex), with page references

Abbreviations

- Should include all the short forms used inside the text with appropriate full forms

Abstract

- Should be within the limit of 200-250 words
- Provides the summary of overall Manuscript (Mini-Thesis)
- First, briefly introduce your research with its purpose
- Then provide the methodology followed by you, including site selection, population and sampling, data collection, research design, treatments, etc.
- Present your major findings from the study/research
- Finally, mention the major conclusion of your research with its implications or ramifications, lessons learned and your recommendation, including policy recommendations, if any

B. MAIN TEXT

Chapter 1: Introduction (4-6 pages)

1.1. Background Information

- Provide background information leading to your research
- Setting the context of your research
- Contains facts, trends, point of views, opinions, etc. as drawn from previous literature, etc.

1.2. Problem Statement

- Logical lead into the problem you are trying to solve based on ground realities, real world problem of farmers, or other such research problems

1.3. Rationale and Justification

- Provide justification for the need of research you are going to conduct
- Explain the significance of this study that also explains the groups that could potentially benefit from this study and the reason they will get benefitted

1.4. Research Questions

- Describe the problems that you are trying to solve through your research
- If you are doing a Case Study, try to explore and describe the issue rather than making any inferences (i.e. explorative and descriptive research)
- In other research, try to make inferences so that you can present what questions do you answered

1.5. Overall Objective

- Based on research question(s) explain the purpose of your research

1.6. Specific Objectives

- You can break down the purpose of your research into more than one objective based on individual research questions (as above)

1.7. Limitation of the Study

- If your research is not exhaustive and covers everything that should be covered under ideal conditions, explain the things that you missed or could not cover or is beyond the scope of your research
- Also discuss if there are any assumption made by you

Chapter 2: Literature Review (8-10 pages)

- Presents the results of previous research related to your study topic, organized by the key variables in your study.
- A conceptual model showing the relationships among variables related to your research problem can also be included.

Chapter 3: Research Methodology / Materials and Methods (8-10 pages)

3.1. Site Selection

- Describe in detail about the site/field selection and logic for it
- Soil, climatic and environmental condition
- Demographics, socio-economic and other such scenarios

3.3. Population, sampling frame, sample size, sampling techniques

- Explain about your population, sampling unit and sampling frame
- Explain in detail about the sample size and reason for the number
- Explain about the sampling techniques and reason for it

3.4. Research design

- Match your research question with your research design
- Explain your plan for the conduction of your research, including experimental designs, design of tools and instruments, etc.
- Explain about treatment, replication, cultivation practices and management, etc.

3.5. Observations and Observation methods

- Data collection methods, Sources of data, types of data
- Interviewing and observation method
- In case study we use mix method both qualitative and quantitative
- Describe about tools of data collection (e.g. FGD, KII, PRA, Questionnaire, etc.)

3.6. Data Analysis and Techniques

- Describes in detail the step-by-step procedures used in analyzing data
- Explain about the software used for data analysis

Chapter 4: Results and Discussion (15-20 pages)

- Reports all results obtained, including all observation, descriptions of data
- Mostly the results are qualitative and explorative with/ without statistical test
- Includes facts only – what was found with explanation, but not interpretation or conjecture by the researcher
- Is organized and written around objectives of the study (research questions)
- Describe, compare, or explain individual and societal knowledge, feelings, values, preferences and behaviors etc. based on your observation

Chapter 5: Summary and Conclusion (3-4 pages)

- Briefly summarizes research, methodology, findings of study and lesson learnt
- States conclusions based upon findings (first point in paper where the researcher is allowed to include his or her own interpretations)
- Describes how findings support or refute related studies (Implications for Current Knowledge).
- Describes implications of findings for those groups affected by the program/findings (Implications for Practice)
- Includes recommendations based upon findings and conclusions
- Includes recommendations for further research

Chapter 6: References

- Enlist all journal articles, books, and other literature reviewed and quoted in the main text in the appropriate format in APA style (Annex VII).

Annexes

- Enlist all other tables, figures, maps of research site, treatment-control design, survey questionnaire, checklists for KII, and case studies, etc. (separately in different Annexes) in this section
- Also, includes copies of all correspondence, instrumentation, and other written communication used in carrying out the research

Additional Note: The Mini-thesis submitted by the student/ student's group must be checked with any authentic plagiarism software before its final approval. Research article may need to comply with the publication where students want to publish his/her article so additional requirements may need to be fulfilled if students want to publish their article outside the FoA's official publication.

Annex VI: Formatting and Style Guidelines for Preparation of Different Types of Technical Documents

- **Font Type:** Tahoma (Bhatta ji! Universities are giving the Times New Roman mostly)
- **Font Color:** Black
- **Font Size:**
 - Main Headings: 16 (Bold)
 - Sub Headings: 14 (Bold)
 - Normal Text: 12 (Regular / Not Bold)
 - Further sub-headings could be separated by making them bold inside the normal text, underlining, or italicizing
- **Spacing:** 1.5 (lines)
- **Alignment:**
 - Cover Page(s): Centered
 - Before Main Text: Justified
 - Main Text: Justified
- **Margins:** 1 inch (all sides)
- **Page Numbering:**
 - Before Main Text: i, ii, (Latin numbers – lowercase)
 - Main Text: 1, 2 (Numerals)
- **For Printed Proposal/Manuscript**
 - **Corrections with fluid:** Not allowed
 - **Overwriting:** Not allowed
 - **Crossing out words:** Not allowed
 - **Typing machine:** Computer
 - **Printing quality:** Laser print
 - **Copies:** High quality photocopy paper

Annex VII: Referencing Guidelines

APA Guidelines should be followed for preparing all types of technical documents to be submitted to FoA. The Supervisor will guide the students in this regard. For majority of literature reviewed following will be applicable (for details see the link at the end of this section/annex):

1. Inside the TEXT:

- **One Author**
("Surname of Author", "Publication Year": p. "Page Number/s")
- **Two Authors**
("Surname of First Author" and "Surname of Second Author", "Publication Year": p. "Page Number/s")
- **More than two Authors**
("Surname of First Author" et. al., "Publication Year": p. "Page Number/s")

2. In the REFERENCE section:

- **One Authors**
"Surname of First Author", "Initials of First and Middle Name of First Author separated by full-stop sign". "Year of Publication". "Title of Publication". "Name of Publisher", "Volume Number" ("Issue Number"): Pp. "Page Number".
- **Two Authors**
"Surname of First Author", "Initials of First and Middle Name of First Author separated by full-stop sign" and "Initials of First and Middle Names of Co-Author separated by full-stop sign", "Surname of Co-Author". "Year of Publication". "Title of Publication". "Name of Publisher", "Volume Number" ("Issue Number"): Pp. "Page Number".
- **More than Two Authors**
"Surname of First Author", "Initials of First and Middle Name of First Author separated by full-stop sign", "Initials of First and Middle Names of Other Authors separated by full-stop sign" "Surname of Other Authors" and "Initials of First and Middle Names of Last Author separated by full-stop sign" "Surname of Last Author". "Year of Publication". "Title of Publication". "Name of Publisher", "Volume Number" ("Issue Number"): Pp. "Page Number".

Link for official document(s) related to APA guidelines:

<https://apastyle.apa.org/style-grammar-guidelines/>

Annex VIII: Evaluation / Marking System for RPS (Practical Portion)

Deliverable	Criteria	PSC Members *	Supervisor**	Total	Deadline
TPP	<ul style="list-style-type: none"> • Adherence with the Guidelines • Uniqueness, Originality and Novelty • Literature referred and Methodology • Workability and Achievability • Content of TPP • Meeting Deadlines 	10	5	15	1 month
TPP Defense	<ul style="list-style-type: none"> • Adherence with the Guidelines • Time taken for Presentation • Presentation Style and Confidence • Ability to Answer & Clarify 	5	5	10	
MPR	<ul style="list-style-type: none"> • Adherence with the TPP (Methodology) • Completeness of Data and Timely Collection • Data Quality • Data Presentation Quality • Content of MPR 	5	10	15	3 months
MPR Presentation	<ul style="list-style-type: none"> • Adherence with the Guidelines * • Time taken for Presentation • Presentation Style and Confidence • Ability to Answer and Clarify 	5	5	10	
Mini-Thesis	<ul style="list-style-type: none"> • Adherence with the Guidelines • Adherence with the TPP (Methodology) • In line with data reported in MPR • Data Analysis Quality and Presentation Style 	10	10	20	6 month

	<ul style="list-style-type: none"> • Inferences, Conclusion and Recommendation 				
Seminar	<ul style="list-style-type: none"> • Adherence with the Guidelines • Time taken for Presentation • Presentation Style and Confidence • Ability to Answer and Clarify 	5	0	5	
Total		40	35	75	

Note: * Guidelines are provided in the Annex IX

If PSC members and supervisors are same or if the Division/Unit has only a limited number of faculty members, appropriate provisions will be made by the Department for avoiding duplication in marking

*** PSC will be made up of up to three-membered team including the Chairperson (in case of Plan-B, one of the member may be the Representative from supporting Organization); PSC can revise the criteria to suit their needs; Average of individual PSC members will be taken for calculating the marks obtained by the student in this category**

**** If more than one supervisor, average will be taken for calculating the marks obtained by the student in this category**

Annex IX: Presentation Preparation Guidelines

1. Presentation should be made within 15 minutes, excluding question answer sessions.
2. There should not be more than 15 slides, excluding one each at the starting and ending.
3. In the Proposal defense, Methodology should be focused and should comprise at least two-thirds of the slides.
4. In the MPR presentation, Field Observations should be focused and should comprise at least two-thirds of the slides
5. In the Mini-Thesis, findings should be focused and should comprise at least two-thirds of the slides
6. Tables, graphs, illustrations, etc. should be used to present data and information, to the extent possible.
7. Heavy animations should not be used. If needed, only simple transitions should be used for illustration purpose.
8. Power Point presentation should be made with template provided by FoA. No tampering and changes are allowed in the design, style, etc. Students should only add the text where appropriate. The template is designed to enhance readability and visibility of texts, etc.
 - The font size in the main slides should be as follows:
 - Heading: 54 (Bold); Preferably One line only
 - Text: 40; Preferably 6-7 lines only

Faculty of Agriculture

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