IAAS CURRICULUM

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

Tribhuvan University
Institute of Agriculture and Animal Science

Revised 2020

The Institute of Agriculture and Animal Science, Tribhuvan University reserves the rights to make changes in this course catalogue without notice.

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FRONT page photograph: Snapping of Wall Poster of National Planning Commission, Singhadurbar, Kathmandu (Courtesy: Prof. Dr. KR Adhikari)
BACK page photograph: Geographical distribution of agricultural campuses of IAAS on the map of Nepal (Courtesy: Prof. Dr. KR Adhikari)

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Foreword

The Institute of Agriculture and Animal Science (IAAS) began as a School of Agriculture in 1957 under the Ministry of Agriculture, and came under Tribhuvan University in 1972. It introduced many academic programs in Agriculture and currently is providing Bachelor, Masters and PhD degree in Agriculture related subjects. IAAS has envisioned to be a leading institute of international excellence in teaching, research and consulting services integrating conventional theory and recent advances in global agriculture.

This bulletin contains information on the B.Sc.Ag. program and the based syllabi provided by IAAS. The new syllabus presented by the IAAS tries to encompass advances in global agricultural studies and research to enable skills and technology development in agriculture and contribute to national productivity. The curriculum revision was due since the 2011, despite several adjustments and revisions over the years. After long efforts of all the subject committees on critically evaluating the existing curriculum and making alterations to adopt the recent advances in agricultural science to coax the graduates for better insights and problem-solving approach, the institute has finally produced the new curriculum for the B.Sc.Ag. degree. Furthermore, the developed curriculum was presented in the Curriculum Development Workshop in the presence of planners, consumer agencies, industries and representative of farming communities. The feedback of the workshop has been critically reviewed and integrated in the finalized curriculum. The curriculum then went through the Faculty Board, and finally recommended to the Academic Council of the Tribhuvan University for endorsement. All the courses offered are based on semester system and are to be instructed in English.

This bulletin presents the academic information, rules and regulations for admission requirements and course description of four-year B.Sc.Ag. program. The output of the curriculum revision is the major change seen in terms of developing micro-syllabus, and emphasis on practical works leading to entrepreneurship and research. Glancing through the program structure and course synopsis, one may note the integrated curriculum that we offer. This uniqueness aptly reflects the IAAS's mission to produce well-round professionals in agricultural sciences.

The curriculum development is a dynamic process which demands continuous efforts of periodic review and updates. I therefore, appreciate the enthusiasm of the subject-committee and faculties for their continuous effort in the process. The consumer societies, planners and agriculture workers should be thanked for their valuable suggestions, comments or criticism to make this curriculum more progressive and relevant for agricultural development of Nepal and elsewhere. I hope, the curriculum amendment and revisions do occur timely in the years to come.

Sincerely,

.....
Prof. Bhargab Dhital
Dean

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1. Introduction

1.1 Objectives of IAAS

The Institute of Agriculture and Animal Science (IAAS) is one of the five technical institutes under Tribhuvan University, Nepal. The mission of IAAS is to produce competent manpower in agriculture and allied disciplines, and to promote research, development and technology dissemination in agriculture. The objectives of IAAS are as follows:

a. Design and implement educational programs in agriculture in order to obtain an appropriate balance among established and emerging needs of the agricultural sector in Nepal and outside.
b. Promote excellence in instruction, research and technology dissemination in agriculture.
c. Develop technically competent agricultural graduates ready to apply the knowledge and skills in technical agriculture, agricultural extension, agricultural education, agribusiness and agricultural and rural development programs.
d. Encourage and support faculty members and students for research and scholarly activities relevant to the needs of Nepalese agriculture and farmers.
e. Foster students' self-development, commitment and responsibility for the welfare of Nepalese society.

1.2 History of Development

The IAAS began as a school of agriculture under the Ministry of Agriculture in 1957A.D. to train Junior Technical Assistants (JTAs) in agriculture. In 1968, the school was upgraded to College of Agriculture and a two-year program of Intermediate of Science in Agriculture (I.Sc.Ag.) was started. In 1972, the College of Agriculture was given the status of IAAS under Tribhuvan University. Until that time, the Institute did not have its own buildings and facilities and was operated at *Jagdamba Bhawan* at Pulchowk in Kathmandu. In 1974, the Institute was relocated from Kathmandu to Rampur, Chitwan - a rural site in Central Terai Nepal where 110 hectares of land, buildings and facilities of the then *Panchayat Training Center* were endowed to IAAS for teaching and research of agricultural science. Later in 1978, Ministry of Agriculture handed over another almost 125 hectares of land to IAAS for developing livestock farm. With the decision of government to establish an Agriculture and Forestry University (AFU) within the premises of Rampur campus, by an Act promulgated in 2010, Rampur campus was relocated to the eastern part of Chitwan in Khairahani municipality. Similarly, Veterinary program was moved to Paklihawa campus and office of the Dean including post-graduate program were shifted to Kirtipur, Kathmandu. At present, the

Institute has four constituent campuses located at Khairahani of Chitwan, Sundarbazar of Lamjung (estd. 1975), Paklihawa of Rupandehi (estd. 1978) and Gauradaha of Jhapa (estd. 2018). Each of the campuses represents typical agro-ecological zones. Number of students enrolment during 2075/76 for B.Sc. Ag. program was 100 in each of Lamjung and Paklihawa campuses. In addition, Paklihawa campus admitted 50 students for Bachelor of Veterinary Science and Animal Husbandry (BV. Sc. & AH). Rampur and Gauradaha Agril. Campuses also enroll 50 students per year. Masters level education in Kathmandu is attracting increasing number of students year after year which is proven by the fact that 15 academic departments run Masters Program at full capacity although required infrastructural facilities are still at the early phase of development.

To respond to growing interest of private sector investment in agricultural education, IAAS has provided affiliation to three colleges for offering B.Sc.Ag. degree. They are situated in Gokuleshwor, Baitadi (named as Gokuleshwor Agriculture and Animal Science Campus, affiliated in 2010), and two others in Dang district called as Prithu Technical College, Lamahi and MARI College of Live Sciences, Tulsipur, both affiliated in 2014). Mahendra Ratna Multiple Campus (MRMC) at Ilam runs B.Sc. Horticulture program in private modality which is under the academic control of IAAS (affiliated in 2016).

1.3 Academic Programs

Bachelor of Science in Agriculture (B.Sc.Ag.): The aim of this program is to train academically competent and practical oriented professional agriculturists. The B.Sc. Ag. program is eight-semester (four years) course after I.Sc. (Basic Science) or 10+2 (Science/Agriculture Science) or I.Sc. (Agriculture). Class room teachings, field and lab works and study visits are the parts of the academic curriculum. Generally, there will be 50 students in a theory and 25 students in a practical class. In the currently revised undergraduate curriculum, the final or the 8th semester students undergo "Fundamental of Research, Practices and Seminar (RPS)" course carrying a teaching load of 4 (1+3) cr. hrs. in lieu of previous "Undergraduate Practicuum Assessment" course of 3 (0+3) cr. hrs. The aim of RPS course is to provide students with an opportunity to learn production and marketing methodologies, data analysis, deliver a result seminar and be able to document a scientific report as a mini-thesis. The students must fulfill four years of residential or non-residential learning to complete the requirements of B.Sc. Ag. curriculum.

Bachelor of Veterinary Science and Animal Husbandry (B.V.Sc. & A.H.): The B.V.Sc. & A.H. program was started at IAAS, Rampur from the academic year 1993/94

(2050/51 B.S.). The aim of this program is to train skilled and competent manpower in the areas of livestock health, production and management. The regular B.V.Sc. & A.H. program is a five years course after I.Sc. (Basic Science) or 10+2 (Science/Agriculture Science) or I.Sc. (Agriculture), which includes nine semesters of academic courses and a final (10^{th}) semester of internship. Generally, there will be 50 students in a theory and 15 students in a practical class following the standard of Nepal Veterinary Council. The curriculum has been designed to integrate basic, practical and clinical subjects to impart both extensive and intensive knowledge in veterinary clinical sciences, animal breeding, livestock production and management.

Bachelor of Science in Horticulture (B.Sc.Hrt.): With the provision of 30 student enrollment, the program was started in 2016 in one of the five departments of MRMC under the academic control of IAAS. The aim of this program is to train skilled and competent manpower in different areas of horticulture harnessing the benefits of unique Mountainous diversities of Eastern Nepal. This is also a four years program with intake of 50 students per year effective from 2020. Generally, there are 50 students in a theory and 25 students in a practical class. A total of 163 cr. hr. are taught in eight semesters including 15 cr. hr. of internship in the last semester.

M.Sc.Ag./M.Sc.An.Sc./M.Sc.Aqua./M.V.Sc.: Master of Science in Agriculture (M.Sc. Ag.) was started in Horticulture, Plant Breeding and Agriculture Economics and Master of Science in Animal Science (M.Sc.An.Sc.) in Animal Nutrition beginning academic year of 1998 A.D. (2055 B.S.). The program was expanded to Agronomy, Plant Pathology, Entomology, Plant Protection, Agriculture Extension and Rural Sociology, Animal Breeding and Fishery (M.Sc.Aqua.) in 1999, Soil Science in 2000 and Livestock Production and Management (LPM) in 2002. M.Sc.Ag. in Environmental Science, M.Sc. in Aquaculture (M.Sc.Aqua.) and Master in Veterinary Science (M.V.Sc.) were initiated in 2004. Currently, Masters program is operating in 15 departments (9 in M.Sc. Ag., 3 in MSc.An.Sc. and 3 in M.V.Sc. Degrees) in Kirtipur, Kathmandu.

Doctor of Philosophy: Doctor of Philosophy (Ph.D.) program in Horticulture and Animal Nutrition was initiated in the January Session of 2002. The program was further expanded to Plant Breeding, Plant Pathology and Entomology in the July Session of 2003. Later on, both coursework-based (Plan-A) and research-based (Plan-B) PhD programs were expanded in many other departments. Currently, the institute runs Ph.D. in many departments except veterinary sciences and plan to include more departments in the future.

1.4 Research Program

The research activities at IAAS are coordinated through the Directorate of Research (DOR). DOR is constituted within IAAS system in order to assist Research Committee which is a recognized body under Tribhuvan University. Funding support for the research activities includes IAAS own fund as well as external funding by national and international organizations. The research findings are being published in IAAS Journal (J. Inst. Agric. Anim. Sci.) annually.

1.5 Agricultural Extension Program

Agricultural education and extension program was regularly initiated only after the establishment of the Directorate of Extension (DOE) in 1999. It organizes short courses for farmers, extension and development workers and provides veterinary health services through the mobile veterinary health camps. It also provides technical services through publications, demonstration and agri-fair organized in collaboration with GOs and I/NGOs. Even plant clinics are run time to time to address farmers' problems, for example, fertilization and irrigation in soils, as well as pathological and entomological problems in the farmers' fields during peak periods of cultivation.

1.6 Physical Facilities

Classrooms and Laboratories: Different building complexes have been developed for B.Sc.Ag. and B.V.Sc. & A.H. programs, which include classrooms, laboratories, stores and office rooms for the faculty members. The laboratories are maintained by the respective departments to support practical training prescribed in the courses. The laboratories are supplied with equipment for basic teaching and analytical works. There are also halls for common activities like seminar, and extra-curricular activities in the campuses.

Student Hostels: There are separate hostel facilities for boys and girls in Lamjung and Paklihawa campuses. The hostels have facilities of common rooms, mess, indoor games and kitchen gardening in addition to bed rooms. Nominal fees, which include electricity charge, internet cost etc, have been charged for the students to maintain the hostels. However, the facility is not enough to accommodate all the students of B.Sc. as well as B.V.Sc. & A.H. in the hostels. Many students still reside outside the campus hostels for the first two-year of four-year study program. The facilities and infrastructures required for hostels in Rampur and Gauradha campuses are in the process of acquiring grants and construction phase.

Library: There are separate libraries in each of the constituent campuses of IAAS. The library maintains mostly purchased, few donated and some research products of teachers and students in the form of books, journals, monographs, theses, annual reports and bibliographies. In addition to text books and reference materials, the library also maintains newspapers and magazines, both national and international. Similarly, the constituent campuses have maintained the e-libraries too. The library is open for the students and faculties everyday except on the public holidays. The construction of a doublestoried, new library building is complete and started functioning in Lamjung Campus. Similarly, a four-storied large building is under construction to accommodate facilities for library and biological laboratory in Gauradaha campus.

Veterinary Teaching Hospital: A veterinary teaching hospital is being developed with modest facilities at Paklihawa campus designed to provide clinical services to farm animals of the farmers from experienced veterinary doctors. Also the veterinary students of latter semesters get practical experience in diseases and other problems faced by the farmers. Veterinary hospital is a most for good practices, and the institute is planning to develop a new veterinary hospital at Paklihawa campus. IAAS is also initiating process to develop a linkage with the government's institutions where intern students involve to increase their practical competency during their final semester.

Farms: Both Lamjung and Paklihawa campuses have their own Agronomy, Horticulture and Livestock farms. These farms support teaching and research requirements and are also used for production purposes. The horticulture farm includes vegetable production block, orchard and space for propagation of fruits, vegetables and ornamental plants. The livestock farm maintains local as well as exotic breeds of cattle, buffaloes, sheep, goat, swine and poultry. Lamjung campus has also a coffee orchard for practical as well as production purposes. Total farm size of Lamjung and Paklihawa campuses is about 16 ha and 35 ha, respectively. The farm products are sold to campus staff and public in a reasonable price. Similarly, newly relocated Rampur campus is acquiring about 236 ha of community forest area in Bhutyaha of Khairahani municipality dominated by Sal trees (*Soria robusta*). In this forest, representative of Inner-Terai riverine ecosystem, banana and pineapples are common understory vegetation which allow for all kinds of research opportunities of agro-forestry. On the other hand, representative of outer-Terai region, Gauradaha campus in Jhapa occurs in a unique setting allowing for lowland rice based research opportunity including large natural fish ponds which could be utilized for research, study and commercial purposes. Located in Baigundhara of Jhapa district, this lowland rice area of Gauradaha campus spreads over 50 ha.

Sports and Extra-Curricular Activities: The institute has modest facilities for indoor and outdoor sports, such as football, volleyball, basketball, badminton and table tennis. Television sets have been provided in the boys and the girls' hostels for news update and recreation. The IAAS administration as well as students' organizations particularly free student union organizes events and extra-curricular activities in consultation with Campus Students' Welfare Committee from time to time.

Guest House: There are separate guest houses with kitchen, bathrooms and common halls in all the campuses for official visitors, guests of IAAS, TU, visiting faculty and individuals from other relevant organizations. Nominal charge is levied on the guests, record kept and the income used for repair and maintenance of the guest house. In each campus, employees are deputed to take care of the guests, serve food and maintain the guest houses.

Transportation and Communication: All campuses are linked by all season black topped roads to their district headquarters and highway to go to Kathmandu and other metropolitan cities of the country. The campuses have vehicles for campus chiefs, buses for students, faculty and staff, and tractors for farming purposes. The campuses offer telephone, fax, and internet and electronic mail services for official use, faculties, staff and students. The teachers, staff and students of all campuses have access to use the IAAS website maintained centrally from the Dean's office in Kathmandu.

1.7 Admission, Evaluation and Award of Degree

Admission Requirements for B.Sc.Ag./Hrt. and B.V.Sc. & A.H.

Students with I.Sc. (Basic science) or I.Sc. (Agriculture) or 10+2 (Science/agriculture science) with compulsory Biology (100 marks), Chemistry (100 marks), English (100 marks), Math (at least 50 marks) and Physics (50 marks), securing a minimum of 50 percent marks in aggregate, from Tribhuvan University or from other recognized universities and boards, are eligible to apply for admission to B.Sc.Ag. /Hrt. and B.V.Sc. and A.H. programs. Selection of students for admission is on a merit basis through a competitive entrance examination. Since 2074 BS, optical mark reading (OMR) system is employed for efficient processing and correct scoring of the answers sheets.

Each year, an admission committee formed by the Dean of IAAS, within the framework of TU rules and regulations and undergraduate (UG) bulletin, formulates the policies concerning establishing criteria for students' intake and entrance examinations. A total of 40% seats under reserved quota are allocated to girl students and those belonging to different kinds of disadvantaged groups and leverages given in admission requirements.

However, this is subject to change with national and university policies. The admission related decisions, notice, policies, rules-in-use and practices in B.Sc.Ag. and B.V.Sc. & A.H. programs are publicized in national daily news and the institute's website well in advance of the date of entrance examinations.

Evaluation and Examination System

Semester System: The institute follows a semester system of education. There are two semesters in each academic year. One semester covers a period of 90 effective working days for teaching and about two weeks for final examination.

Teaching Methods: All courses are to be instructed in English. The head of the department or unit of each campus assigns the course to the faculty member after the finalization of the lesson plan as per academic calender of the Dean's Office. All faculty should follow student-centric teaching methods, lecture cum discussion, group based assignment, and presentation as per the course and title concern. The faculty is most liable to complete the courses on time, however chief or concerned official are responsible to ensure quality of education and timely delivery of lecturers.

Evaluation and Examination System: The institute follows semester system of examination for evaluation. A total of 20% of full marks in theory in each subject is evaluated internally through an internal assessment. The concerned teachers conduct this examination after at least half of the course is taught. The students must secure at least 40% marks in the internal assessment to qualify for final examination. The course teacher gives only one chance for makeup test to those who fail in the first internal assessment or missed it for a valid reason.

Examination Control Division of IAAS: Dean office, under the rules and regulations of the Examination Board of Tribhuvan University, independently conducts semester examinations. In theory part, 80% of total marks is allocated to the semester examinations and remaining 20% of the marks is allocated to internal assessment examinations. In the case of practical part of the subject, there is no system of internal assessment examination. In each subject, the course teacher serve as an internal examiner and another teacher from the same department serves as an external examiner to conduct practical semester examination. A student must secure at least 40% marks in theory and practical separately to pass in the final theory and practical examinations in each subject. The students who fail in the final theory or practical examination are allowed to take a Back Paper Examination in about one month from the date of announcement of results of regular semester. Re-totalling of marks for board exam is done as per the rules and regulation TU examination board.

Attendance Requirements: A student must attend at least 70% of classes in each subject to be eligible for final examination. Failure to meet the minimum attendance requirement may debar a student from taking final examination. For only practical courses, a student must have attended the practical classes as reflected in the attendance register of the course instructor.

Award of Degree and Transcript of Academic Records: A student becomes eligible for receiving the award of B.Sc.Ag. or B.V.Sc. & A.H. degree after completion of all the requirements prescribed by the curriculum. No partial degree shall be awarded in case a student fails to complete any of the prescribed requirements. Examination Board of IAAS declares results of semester examination. The Controller of Examination of TU then issues transcript of Academic Records after the mark sheets are submitted by the Examination Control Division of IAAS. For the uniformity within TU system, IAAS is also in the process of transforming percentage into Letter grading system in the transcript. The standing of the students is based on aggregate percentage of marks as under:

Distinction	80%
First Division	65%
Second Division	50%
Pass	40%
Fail	<40%

1.8 Students' Welfare

General: The facilities for students' welfare at IAAS campuses include students' hostels, health care and medical facilities and facilities for sports, extra-curricular activities and recreation. A member from IAAS faculty is appointed as an extra-curricular activity chief to organize and coordinate sports and other extra-curricular activities. In addition, students clubs, free student union and cultural groups also organize extra-curricular activities from time to time.

Scholarship: The institute provides scholarship to topper students one from girls and one from boys at the rate of NRs 9000 in each semester. In the first semester, topper students are selected on the basis of overall quiz marks of all the subjects; and in other semesters, on the basis of final results of each semester. In addition, 15% of the students receive freeship, on the same basis as above that waives payment of the tuition fee in each semester. The award of scholarship is however subjected to change depending upon availability of funds and policy of Tribhuvan University.

1.9 Design and Delivery of Curriculum

The curricula of B.Sc.Ag. and B.V.Sc. & A.H. programs include courses in basic and core disciplines. Some courses also reflect nature specific to agro-climatic and physiographic settings of Nepal and Nepalese farming systems. The members of Subject Matter Committees of IAAS, and others representing experts from Nepal Agriculture Research Council (NARC), Department of Agriculture under Ministry of Agriculture and Development and other stakeholders, in different areas of agriculture and veterinary sciences, design and propose the courses for periodic revision. The content of the courses are critically discussed and modified by the Faculty Board of the institute. The course curriculum is implemented after approval of the Academic Council of Tribhuvan University. The management and delivery of the courses of both the programs are carried out through the respective departments.

Course Code: The course codes listed in this curriculum have a short text 'abbreviation' of the subject matter. The digits are read from left to right. The first digit indicates the year in which course is offered, the second digit indicates the first (1) or the second (2) semester of the academic year and the third digit indicates serial number of the course in sequence in the semester offered by an instructional department. Each theory or practical credit hour is equivalent to 25 marks. For example, a course with credit hours of 2+1 has full marks of 75 (Theory 50 and practical 25). One credit means one hour of lecture in theory and two to three hours for practical per week.

Courses: This revised curriculum presents micro-syllabus in order to help teachers plan according to the limits and specificity of the courses for teaching. Among others, two major shifts made in this curriculum are: i) Agriculture Enterprise Learning Program (ELP) 3 (0+3) has replaced the Project Work course and ii) Fundamental of Research, Practices and Seminar (RPS) 4 (1+3) has replaced the Work Experience Program offered in the earlier curriculum to help develop research and entrepreneurship capability of the students. In order to earn the degree, the students are required to accomplish all the courses offered by each department in each semester. Generally introductory courses are offered in the initial semesters and more practical-oriented or problem solving type courses in the latter semesters. A summary of courses offered by each department in each semester is given in the following chapter.

1.10 Other Rules and Requirements

The aspects of instruction, evaluation, and other areas of academics, not mentioned in this bulletin have to follow the rules and regulations of the Tribhuvan University by default.

2. Brief Outline of Courses

2.1 Semesterwise distribution of courses and credit hour

Semester	CC and Cr hr	Course Title
First	AEC111 (2+0)	Principles of Economics
	AGR111 (2+1)	Principles of Agronomy
	HRT111 (2+1)	Introductory Horticulture
	SSC111 (2+1)	Fundamentals of Soil Science
	ABE111 (2+1)	General Biochemistry
	LPM111 (2+1)	Introductory Animal Science
	PLB111 (2+1)	Principles of Genetics
	EXT111 (2+1)	Fundamentals of Rural Sociology and Educational Psychology
First	**16+7=23**	
Second	AEC121 (2+1)	Farm Management and Production Economics
	AGR121 (2+1)	Agronomy of Cereal Crops
	ENT121 (2+1)	Introductory Entomology
	PLP121 (2+1)	Introduction to Plant Pathology
	HRT121 (2+1)	Ornamental Horticulture
	SSC121 (1+1)	Soil Physics, Genesis and Classification
	ABE121 (2+1)	Introductory Crop Physiology
	ANU121 (1+1)	Fodder Production and Pasture Management
Second	**14+8=22**	
Third	AEC211 (2+0)	Natural Resource Economics
	AGR211 (2+1)	Agronomy of Grain-Legumes and Oilseed Crops
	PLB211 (2+1)	Principles and Practices of Plant Breeding
	ENT211 (2+1)	Principles and Practices of Insect-Pest Management
	PLP211 (2+1)	Crop Diseases and Management
	HRT211 (2+1)	Vegetable and Spice Crop Production
	SSC211 (2+1)	Soil Fertility Management
	ABE211 (1+1)	Agricultural Microbiology
	LPM211 (1+1)	Ruminant Production
Third	**16+8=24**	

Semester	CC and Cr hr	Course Title
Fourth	AEC221 (2+0)	Nepalese Agriculture Planning and Policies
	AGR221 (1+1)	Agronomy of Commercial Crops
	AST221 (2+1)	Agricultural Statistics
	HRT221 (2+1)	Fruit and Plantation Crop Production
	AEN221 (2+1)	Farm Power and Machinery
	ENT221 (2+1)	Economic Entomology
	LPM221 (1+1)	Pig and Poultry Production
	ELP221 (0+1)	Agri-enterprise Learning Program-I
	AQF221 (1+1)	Introductory Ichthyology
Fourth	**13+8=21**	
Fifth	AEC311 (2+1)	Agriculture Marketing, Cooperatives and International Trade
	EXT 311 (2+1)	Fundamentals of Agricultural Extension
	AGR311 (1+1)	Principles and Practices of Weed Management
	ELP311 (0+1)	Agri-enterprise Learning Program-II
	HRT311 (2+1)	Protected and Precision Horticulture
	AEN311 (1+1)	Introductory Agro-meteorology
	SSC311 (2+0)	Introductory Soil Conservation and Watershed Management
	ABE311 (1+1)	Medicinal and Aromatic Plants
	ANU311 (1+1)	Animal Nutrition and Feeding Practices
	AQF311 (1+1)	Principles of Aquaculture
Fifth	**13+9=22**	
Sixth	AEC321 (2+1)	Agriculture Project Planning and Management
	EXT321 (2+1)	Agricultural Communication
	AGR321 (2+1)	Seed Science and Technology
	HRT321 (1+1)	Agroforestry
	PLB321 (2+0)	Molecular Genetics and Bioinformatics
	ABE321 (2+1)	Agro-biodiversity and Ecology
	ANB321 (2+1)	Principles and Practices of Animal Breeding
	ENT321 (1+0)	Pesticide Pollution and Environment Protection
	AQF321 (1+1)	Inland Fisheries and Limnology
	ELP321 (0+1)	Agri-enterprise Learning Program-III
Sixth	**15+8=23**	

Seventh	AEC411 (2+1)	Agribusiness Management and Financing
	EXT411 (2+1)	Social Mobilization and Community Development
	AGR411 (2+0)	Farming System and Advances in Agriculture
	LPM411 (2+1)	Dairy Science and Technology
	PLP411 (1+1)	Seed Pathology
	PLP412 (0+1)	Mushroom Cultivation
	HRT411 (2+1)	Post-harvest Horticulture
	AEN411 (2+1)	Principles and Practices of Irrigation Management
	LPM412 (1+1)	Animal Ethics and Welfare
Seventh	**14+8=22**	
Eighth	AGR421 (1+1)	Organic Farming and Sustainable Agriculture
	AEN421 (1+1)	Farm Structure and Surveying
	PLB421 (2+0)	Modern Plant Breeding and Biotechnology
	RPS421 (1+3)	Fundamental of Research, Practices and Seminar
Eighth	**5+5=10**	
Total	**106+61=167**	

CC-Course Code; Cr.hr.- Credit hour (Theory+Practical)

2.2 Semesterwise credit hour

Semester	**Credit hour**		
	Total	**Theory**	**Practical**
First	23	16	7
Second	22	14	8
Third	24	16	8
Fourth	21	13	8
Fifth	22	13	9
Sixth	23	15	8
Seventh	22	14	8
Eighth	10	5	5
Grand total	**167**	**106**	**61**

2.3 Departmentwise credit hour

Department	Code	Credit hours		
		Theory	Practical	Total
Departmentwise courses				
Agriculture Botany and Ecology	ABE	8	5	13
Agricultural Economics	AEC	14	4	18
Agronomy	AGR	13	7	20
Entomology	ENT	7	3	10
Agricultural Extension	EXT	8	4	12
Horticulture	HRT	13	7	20
Plant Breeding	PLB	8	2	10
Plant Pathology	PLP	5	4	9
Soil Science and Agri-Engineering	SSC, AEN	13	7	20
Livestock Production and Management	LPM	7	5	12
Animal Breeding	ANB	2	1	3
Animal Nutrition and Fodder Production	ANU	2	2	4
Aquaculture and Fisheries	AQF	3	3	6
Interdepartmental courses				
Agricultural Statistics	AST	2	1	3
Enterprise Learning Program-I, II & III	ELP	0	3	3
Research, Practices and Seminar	RPS	1	3	4
Grand Total		**106**	**61**	**167**

3. Departmentwise Courses

3.1 Agricultural Botany And Ecology

Course Code : ABE 111
Course Title : General Biochemistry
Credit Hour : 3 (2+1) Full mark: 75 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, students will be able to understand the basics of biochemistry: the fundaments, how plant and living entity are composed and how they behave in a molecular level. They will be able to understand the composition, structure, functions and properties of biomolecules and correlate with plant science.

Syllabus

Introduction, history, scope, importance and practical application of biochemistry in agriculture. Membrane and transport system of plant cell. Transport across cell membrane, osmosis, diffusion, active and passive transports. Water and electrolyte, Donnan membrane equilibrium. Acid-base, biological buffer system. Structure, classification and functions of carbohydrates, proteins and lipids. Structural organization of protein, cholesterol, prostaglandins and bile salts. Structure and types of nucleic acids: DNA and RNA. Enzymes, kinetics and mechanism of action and enzyme inhibition. Glycolysis, TCA, HMP shunt, protein degradation, urea cycle, rotenone, oxidative phosphorylation and potent inhibitors of electron transport chain, cyanide and carbonmonooxide.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction: Introduction, history, scope, importance and practical application of biochemistry in agriculture	1
2.	Membrane and transport system of plant cell	2
2.1	Composition of biological membranes, fluid-mosaic model	
2.2	Transport across cell membrane, osmosis, diffusion, active & passive	
3.	Water, pH and buffer in biological system	3
3.1	Water and electrolytes; ionization of water, cations and anions, and Donnan membrane equilibrium	
3.2	Acid and base; Arrehenius, Bronsted- Lowry, Lewis concept, dissociation constant	

3.3	pH & homeostasis, biological buffers, and Henderson-Hasselbalch equation	
4.	Biochemistry of carbohydrates	3
4.1	Definition, functions, occurrence and classification of carbohydrates on the basis of hydrolysis, reducing behavior and solubility	
4.2	Physical properties, stereoisomerism-functional group isomers, epimers, optical isomers, anomers, mutarotation, & chemical reactions: oxidation & reduction of monosaccharides	
4.3	Structure of ribose, glucose, fructose, galactose, mannose, aminosugars, maltose, iso-maltose, lactose, sucrose, starch, dextrins, glycogen, cellulose, inulin & chitin	
5.	Biochemistry of proteins	3
5.1	Amino acids: definition, structure, properties-amphoteric nature, optical activity, & classification basis on their side chain, metabolic fate & nutritional value	
5.2	Protein: peptide bond, classification based on functions, structure & composition	
5.3	Structural organization of protein, denaturation, misfolding and prion disease	
6.	Biochemistry of lipids	3
6.1	Fatty acid: structure, function and classification, essential fatty acids and PUFA	
6.2	Structure and classification of lipids: simple, compound and derived lipids	
6.3	Structure and function of cholesterol, prostaglandins and bile acids	
7.	Biochemistry of Nucleic acids	3
7.1	Nitrogenous bases; purines & pyrimidines, nucleoside & nucleotides with structure	
7.2	Structure, functions and types of DNA and RNA, Watson & Crick model of DNA, mRNA, tRNA, rRNA and hnRNA	
7.3	Organization of DNA, supercoiling, histone protein, nucleosome, chromatin and chromosomes	
8.	Enzymes	3
8.1	Definition, nomenclature and classification, coenzymes, cofactors, activators, apo- enzyme and holoenzyme	
8.2	Mechanism of enzyme action, enzyme kinetics, Michaelis Menten equation-its significance and enzyme specificity	
8.3	Factors affecting enzyme activity (substrate, product, enzyme concentration, temperature, pH, activators and inhibitors)	
9.	Carbohydrate metabolism	4

9.1	Biosynthesis of sucrose, starch and glycogen	
9.2	Glycolysis: significance, fate of pyruvate in aerobic and anaerobic conditions	
9.3	TCA: location, steps & significance, common metabolic & amphibolic pathway	
9.4	Pentose phosphate pathway: location and significances	
10.	Protein metabolism	2
10.1	Overview of protein degradation, ubiquitination-role during protein degradation	
10.2	Transamination, deamination, trapping of ammonia & its detoxification, urea cycle	
11.	Electron Transport Chain	3
11.1	Enzymes involved in oxidation- reduction, and electron carriers	
11.2	Oxidative phosphorylation, and chemiosmotic theory of ATP synthesis	
11.3	Shuttle system involved in ETC and potent inhibitors of ETC (Rotenone, Cyande, and hxCarbon monooxide)	
	Total	30

Practical

S.N.	Topic	No. of practical
1	Introduction and use of laboratory equipments and glass wares	1
2	Preparation of standard solutions: normal, molar and percentage solutions	1
3	Titration curve of amino acid	1
3	Preparation of colloidal solutions	1
4	Preparation of buffer solutions and determination of pH	1
5	Identification of carbohydrate and qualitative estimation of reducing and non-reducing sugars	2
6	Qualitative estimation of protein	1
7	Qualitative estimation of lipids	1
8	Quantitative estimation of blood glucose by GOD POD method	1
9	Determination of iodine number in vegetable oils	1
10	Quantitative estimation of cholesterol.	1
11	Demonstration of spectrophotomer, gel electrophoresis, thin layer and paper chromatography	3
	Total	**15**

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Plummer, D.T. 2004. An introduction to bractical biochemistry. Tata McGraw Hill, New Delhi.
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Course code : ABE 121
Course Title : Introductory Crop Physiology
Credit Hour : 3 (2+1) Full mark: 75 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, students will be acquainted with fundamental physiological processes and functions taking place in crop plants.

Syllabus

Introduction to crop physiology and bio-physico-chemical phenomenon. Absorption and translocation of water and minerals. Photosynthesis, respiration and translocation of photosynthates. Production of secondary metabolites and physiology of plant defense mechanism. Physiology of growth and development and stress physiology.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction : definition, scope, importance and practical application of crop physiology in agriculture	1
2.	Introduction to cell physiology	
2.1	Definition to key concepts; overview of a typical plant cell structure	1
2.2	Structure and functions of cell wall, cell membranes and cell organelles	1
3.	Biophysical phenomenon in plant cells	
3.1	Practical application of thermodynamics in plants	1
3.2	Role of diffusion and osmosis in crop physiology	1
3.3	Concepts of water potential and water use efficiency in crops	1

4.	Absorption and translocation of water and nutrients	
4.1	Properties and role of water in plants; and absorption of water	1
4.2	Transpiration and its type and stomatal physiology (structure, distribution, opening and closing of stomata)	1
4.3	Ascent of sap	1
4.4	Ion uptake and its mechanism	1
4.5	Nutrio-physiology; Mengel's classification of plant nutrients and physiological functions of plant nutrients	1
4.6	Physiology of foliar nutrition, aeroponics and hydroponics	1
5.	Photosynthesis	
5.1	Photosynthetic apparatus and light reaction	1
5.2	C3 cycle and photorespiration	1
5.3	C4 cycle and CAM cycle	1
5.4	Factors affecting photosynthesis	1
6.	Respiration	
6.1	Concepts, glycolysis and fate of pyruvate	1
6.2	TCA cycle and electron transport chain	1
6.3	Factors affecting respiration	1
7.	Translocation of photosynthetic products and production of secondary metabolites	
7.1	Phloem anatomy, apoplastic and symplastic transport and source and sink concept	1
7.2	Phloem loading and unloading; transport mechanisms and dry matter partitioning	1
7.3	Introduction to plant defense mechanism and production of secondary metabolites	1
8.	Physiology of growth and development in crops	
8.1	Growth and development, measurement of growth and physiological responses that affect growth, development and yield of crops	1
8.2	Physiology of seed germination: concepts and types of seed germination, physiological and biochemical changes during seed germination	1
8.3	Seed dormancy, types, causes and removal of seed dormancy	1
8.4	Physiology of flowering; photoperiodism and vernalization	1
9.	Plant growth regulators	
9.1	Plant growth regulators: classification occurrence and biosynthesis of auxin, gibberellin, cytokinin, ABA and ethylene	1
9.2	Physiological role and mode of action of growth regulators in crop plants	1
10.	Stress physiology	
10.1	Physiology of drought, submergence and anoxia stress	1
10.2	Physiology of temperature, salt and radiation stress	1
	Total	**30**

Practicals

S.N.	Topic	No. of practical
1.	Introduction to equipments and chemicals used in crop physiology lab	1
2.	Isolation of cell organelles by centrifugal process	1
3.	Determination of DPD of potato tubers by gravimetric methods/ plasmolytic methods	1
4.	Estimation of water potential by Chardakov's method	1
5.	Study of transpiration process with the help of cobalt chloride paper and potometer.	1
6.	Study of structure and distribution of stomata in monocot and dicot leaves	1
7.	Demonstration of photosynthetic pigments by paper chromatography	1
8.	Study the factors affecting the process of photosynthesis	1
9.	Study of deficiency symptoms of mineral nutrients in field	1
10.	Study of anatomy of c3 and c4 plant leaves	1
11.	Effect of GA on seed germination	1
12.	Leaf area measurement and calculation of leaf area index	1
13.	Seed testing for moisture, viability and vigor	1
14.	Germination under different moisture and temperature regimes	1
15	Calculation of various growth parameters and yield analysis.	1
	Total	**15**

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Course Code : ABE 211
Course Title : Agricultural Microbiology
Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

Upon the completion of this course, students will be able to understand the basics of agricultural microbiology, roles of microorganisms in crop productivity and soil fertility and usability in day to day agricultural practices.

Syllabus

Introduction to microbiology, historical development, scope, importance and practical application of microbiology in agriculture. Characteristics of prokaryotic and eukaryotic microorganisms, nutrition and genetics of bacteria, role of microorganisms in soil fertility and crop production, interrelationship between microorganisms and plants, biodegradation of agrochemicals and bioremediation. Aerobic and anaerobic microbial degradation of carbohydrates, proteins and fats in organic residues. Introduction to plant pathogenic microorganisms in food, dairy products and food spoilage (contaminations and toxins). Microorganism in human welfare (alcohol, antibiotics, bio-fertilizers, waste treatment, bioconversion and biopesticides).

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction to microbiology and microorganisms	
1.1	Evolution of microbial life; introduction, historical development, scope and importance of microbiology; and practical application in agriculture	1
1.2	Basic characteristics of prokaryotic and eukaryotic microorganisms	1
2.	Microbial nutrition and genetics	
2.1	Nutritional requirements of bacteria and microbial growth curve	1
2.2	Genetics of bacteria: conjugation, transformation and transduction	1
3.	Role of microorganisms in soil fertility and crop production	
3.1	Rhizosphere and phyllosphere effects and manipulation of rhizosphere microflora to sustain plant productivity.	1
3.2	Factors influencing the activities of soil microorganisms and role of microorganisms in formation of soil organic matter	1
4.	Interrelationship between microorganisms and plants	

4.1	Introduction to biological nitrogen fixation: symbiotic, associative and non-symbiotic	1
4.2	Mechanism of root nodule formation and symbiotic nitrogen fixation in legumes	1
4.3	Basic concept on phosphobacteria and mycorrhizae; microorganisms and plant diseases with prime focus on signs and symptoms	1
5.	Biodegradation of agrochemicals and organic residues	
5.1	Biodegradation of aliphatic compounds and aromatic compounds	1
5.2	Bioremediation: key concept, principle and process	1
5.3	Microbial degradation of organic residues (carbohydrates, proteins and fats)	1
6.	Microorganisms involved in food products and food spoilage (infections and toxins) and principle of food preservation	1
7.	Alcohol fermentation and beverages; biogas, water purification and effluent management and antibiotics	1
8.	Biofertilizers: importance and mass production; biopesticides and bioconversion of agricultural wastes for compost making	1
	Total	**15**

Practicals

S.N.	Topic	No. of practical
1	Handling of microscope and micrometry-measurement of microorganisms	1
2	Types and methods of sterilization	1
3	Media for microbial culture (PDA/Czapek's/nutrient agar/ Richard's media)	1
4	Isolation of bacteria by streak plate method	1
5	Enumeration of bacteria by pour plate method and spread plate method	1
6	Purification and preservation of microbial culture	1
7	Staining techniques in bacteria and fungi	1
8	Morphological characteristics of bacteria and fungi	1
9	Microscopic examination of bacterial and fungal cultures	1
10	Experiment in urea hydrolysis	1
11	Microscopic study of heterocyst of BGA	1
12	Demonstration of fermentation process	1
13	Isolation and morphological examination of *Rhizobium* from root nodules	1
14	Mass culture of bacterial bio-fertilizer (*Rhizobium*)	1
15	Acquaintance and use of effective microorganisms	1
	Total	**15**

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Course Code : ABE 311
Course Title : Medicinal and Aromatic Plants
Credit Hour : 2 (1+1) Full mark: 50 Theory: 25 Practical: 25

Objectives

Upon completion of the course, students will be able to understand the importance of medicinal and aromatic plants (MAPs), their traditional uses, high value MAPs of Nepal and aspects of MAPs cultivation.

Syllabus

Introduction to Medicinal and Aromatic Plants (MAPs), processing of MAPs, plant profile: description, origin, distribution, cultivation, management, harvesting, chemical evaluation and uses of medicinal and aromatic plants. Process of domestication of high value MAPs, Regulation and quality control, conservation and sustainable use of MAPs.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to Medicinal and Aromatic Plants	
1.1	Importance, history, prospects and constraints of MAPs in Nepal	1
1.2	Classification and need of research and development of MAPs	1
2.	Process of domestication of high value medicinal and aromatic plants	1
3.	Post-harvest handling and extraction techniques	
3.1	Drying, processing, grading, packing, storage and quality standards in herbal products	1

3.2	Distillation methods, solvent extraction process and advance methods for extraction of active ingredients	1
3.3	General phytochemicals extraction techniques	1
4.	Regulations and marketing of MAPs in Nepal	
4.1	CITES and IUCN clauses and concept of threatened and endangered species	1
4.2	Marketing of MAPs in Nepal, legal provision for management of MAPs in Nepal	1
4.3	Conservation and sustainable use of MAPs	1
5.	Plant profile, description, origin, distribution, cultivation, management, harvesting, chemical evaluation and uses of selected medicinal and aromatic plants	
5.1	*Aloe vera* and *Acorus calamus*	1
5.2	*Rauvolfia serpentina* and *Azadirachta indica*	1
5.3	*Swertia chirayita* and *Elaeocarpus spp.*	1
5.4	*Citronella* and *Nardostachys grandiflora*	1
5.5	*Ocimum sanctum* and *Taxus wallichiana*	1
5.6	*Cordyceps sinensis* and *Rhododendron* spp.	1
	Total	**15**

Practicals

S.N.	Topic	No. of practical
1.	Identification, recording and reporting the uses of locally available medicinal and aromatic plants	1
2.	Nursery bed preparation for medicinal and aromatic plants cultivation	1
3.	Planting of medicinal and aromatic plants	1
4.	Drying and processing of medicinal and aromatic plants	1
5.	Preparation of extracts of various medicinal and aromatic plants	1
6.	Phytochemical screening for alkaloids, flaveniods, tannins, saponins, quinones and terpenoids	1
7.	Quantification of total alkaloids in a given plant sample	1
8.	Proposal design regarding documentation of ethno-medicinal knowledge	2
9.	Preparation of questionnaire for recording traditional uses of locally available herbs	1
10.	Pretesting of questionnaire for recording traditional uses of locally available herbs	1
11.	Market survey of herbal products	1
12.	Field observation of herbal farms and processing plants	1
13.	Herbarium preparation and display of high value medicinal and aromatic plants	2
	Total	**15**

References

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Course Code : ABE 321
Course Title : Agrobiodiversity and Ecology
Credit Hour : 3 (2+1) Full mark: 75 Theory: 50 Practical: 25

Objectives

Upon completion of the course, students will have the basic understanding about various concepts on agro-ecology, climate change, biodiversity management, EIA and various other aspects of agroecosytem.

Syllabus

Introduction to agro ecology. Functional traits in agriculture: agrobiodiversity and ecosystem services. Agricultural ecosystem dynamics and population ecology; environmental and social issues affecting agrobiodiversity and ecosystem; environment impact assessment in agriculture; agrobiodiversity and climate change; neglected and underutilized species in agriculture. Adding values to agrobiodiversity management, sustainability of agroecosystem, alternative agroecological models, conserving biodiversity and increasing resiliency. Policy and institutional mechanisms.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction to agroecology	
1.1	Definition, scope, importance, history and approaches of agro ecology	1
1.2	Properties of ecosystem (productivity, stability, equitability and sustainability) and succession (types and causes). Energy flow in an ecosystem	1
1.3	Harlan's biome concept and agriculture. Components, principles, benefits and applicability of home garden	1
2.	Functional traits in agriculture: agrobiodiversity and ecosystem services	
2.1	Concept, status, importance, prospects and threats to agrobiodiversity	1
2.2	Ecosystem services of biodiversity, biodiversity and economics with special reference to Nepal.	1
2.3	Farmer's knowledge and agrobiodiversity (farmer as breeder and banker)	1
3.	Agricultural ecosystem dynamics and population ecology	
3.1	Biotic and abiotic factors affecting the dynamics of the agroecosystem	1
3.2	Species interaction in agroecosytem	1
4.	Environmental and social issues affecting agroecosystem	
4.1	Increasing agricultural intensification and expansion, and minimizing the negative implication of farm intensification on downstream ecosystem	1
4.2	Land fragmentation, pesticides misuse and impacts of long term application of agrochemicals on ecosystem	1
4.3	Genetic pollution, germplasm conservation, benefits and risk of GMO	1
4.4	Effect of various agricultural systems on biodiversity, and problems associated with exotic and invasive species in agriculture	1
5.	Environmental impact assessment in agriculture	
5.1	Concept and principle of EIA, and comparison between EIA and IEE	1
5.2	Methods of impact identification of agricultural intensification and environmental audit	1
6.	Agrobiodiversity and climate change	
6.1	Definition to key concepts, source and sink of greenhouse gases, and uncertainty about climate change forecasting	1
6.2	Impacts of climate change in agriculture and role of agriculture in climate change	1
6.3	Adaptation and mitigation strategy towards climate change; LAPA and NAPA	1
7	Neglected and underutilized species in agriculture	

7.1	Neglected and underutilized species (NUS): status, challenges and way forward	1
7.2	Importance of NUS in context of Nepal and the world	1
8	Adding values to agrobiodiversity management	
8.1	Registration of agricultural resource, CBR and CBM.	1
8.2	Breeding: PPB and PVS; value chain and conservation of agrobiodiversity	1
8.3	Linking of agrobiodiversity to market and economic incentives for ecological farming practices	1
9.	Sustainability of agroecosystem	
9.1	Concepts, principles, indicators and challenges for agricultural sustainability	1
9.2	Basic ecological concepts on biodiversity conservation and enhancement of ecosystem health and resiliency	1
9.3	Analysis of sustainable farming system; IDEA and MESMIS concepts for sustainability measurement	1
10.	Alternative agroecological models conserving biodiversity and increasing resiliency	
10.1	Natural resource management in agroecosytem (concept, issues and challenges) and natural farming model (Fukuoka)	1
10.2	Biodynamic agriculture (Steiner), perennial polyculture (Jackson) and holistic resource management (Savory)	1
11.	Policy and institutional mechanisms	
11.1	CBD and its implication in agriculture; international treaty on PGRFA, farmer's right, and biosafety	1
11.2	Various acts and policies targeted towards environmental management in Nepal	1
11.3	Institutions involved in conservation of biodiversity and agroecosystem in Nepal	1
	Total	**30**

Practicals

S.N.	Topic	No. of practical
1	Record and analyze the climatic data with respect to cropping system	1
2.	Documentation of agrobiodiversity components present at your campus vicinity	1
3	Data collection and report preparation on linkages of farmers with agro-ecosystem and record agrobiodiversity components	2
4	Calculate density, abundance, frequency, their relative values and IVI of various species present in agroecosystem	1
5	Calculate similarity indices of the recorded weeds data	1

6	Seed collection and catalogue preparation of local and improved varieties	1
7	Water quality test (dissolved oxygen, pH, temperature and dissolved solid) of various water samples	1
8	Test for presence of nitrate, chlorine and pesticides residue in water sample by kit method.	1
9	Preparation of statement of environmental impacts of local industries and or developmental activities in agroeosystem	1
10	Study of on-farm conservation strategies adopted by farmers near to campus vicinity	1
11	Case study on various pertinent topics of agrobiodiversity or agroecosytem management	2
12	Preference analysis of some selected NUS used by local ethnic people	1
13	Exploration on value addition of agrobiodiversity by local ethnic people	1
	Total	**15**

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3.2 Agricultural Economics

Course Code : AEC 111
Course Title : Principles of Economics
Credit Hour : 2 (2+0) Full mark: 50 Theory: 50 Practical: 00

Objectives

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

Syllabus

Definitions of economics - Adam Smith, Marshall and Robbins; subject matter and nature of economics; basic concept on economics; law of diminishing marginal utility; indifference curves and their analysis; price effect - income and substitution effects; demand - concept, determinants, law and elasticity; supply - concept, determinants, law and elasticity; cost concept, cost curves and their relationships; market – concept and forms; monopoly and monopolistic markets; definition, characteristics and theories of land (rent), labour (wage), capital (interest) and organization (profit); Malthusian and optimum theories of population.

Outline

Theory

S.N.	Topic	No. of lecture
1	Basic concepts on economics	
	Concept on goods, utility, value, price, wealth, production, consumption, equilibrium, margin, national income and GDP	**1**
2	Concept, definition, nature and subject matter of economics	
2.1	Concept of economics, micro and macro economics, importance of economics	**1**
2.2	Definition by Adam Smith and Marshall	**1**
2.3	Definition by Robbins and comparisons between three definitions	**1**
2.4	Subject matter and nature of economics	**1**
3	Consumer behavior	
3.1	Concept and assumptions of ordinal and cardinal approach of utility measurement	**1**
3.2	Concept, assumptions, application and exceptions of law of diminishing marginal utility	**1**
3.3	Indifference curve and its properties	**1**

3.4	Price effect: income and substitution on normal, inferior and Giffen goods	**1**
4	Demand	
4.1	Demand concept and determinants of demand	**1**
4.2	Law of demand (concept, reasons and explanation) and change in demand	**1**
4.3	Elasticity of demand: concept, types and degrees	**1**
4.4	Measurement of elasticity of demand	**1**
5	Supply and cost	
5.1	Supply concept and determinants of supply	**1**
5.2	Law of supply and change in supply	**1**
5.3	Elasticity of supply and its measurement	**1**
5.4	Types of cost, cost curves and their relationships	**1**
6	Market	
6.1	Concept and types of market structures	**1**
6.2	Characteristics and price determination on perfect competition market	**1**
6.3	Characteristics and price determination on monopoly market	**1**
6.4	Characteristics and price determination on monopolistic market	**1**
7	Land and rent	
7.1	Definition and characteristics of land	**1**
7.2	Theories of rent: Ricardian and modern theory of rent	**1**
8	Labour and wage	
8.1	Definition and characteristics of labour	**1**
8.2	Theories of wages: modern and marginal productivity theory of wages	**1**
9	Capital and interest	
9.1	Definition, characteristics and types of capital, concept of interest	**1**
9.2	Theories of interest: liquidity preference and modern theory of interest	**1**
10	Organization and profit	
10.1	Concept and types of organization and profit	**1**
10.2	Theory of profit: Schumpeter theory of profit	**1**
11	Theories of population: Malthusian and optimum with merits and demerits	**1**
	Total	**30**

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Course Code : AEC 121

Course Title : Farm Management and Production Economics

Credit Hour : 3(2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

The course provides comprehensive knowledge to students about principles and techniques of farm management and production economics and also deals with how a particular producer or a firm maximizes his profit and minimizes his cost.

Syllabus

Farm management - definition, nature and scope in Nepalese context; relationship with other sciences; meaning of production, production relationships and economic optimum - factor-product, factor-factor and product-product; three stages of production function and its application; principles of farm management; farm planning and budgeting – concept, characteristics, types and techniques; farm records - farm inventory, balance sheet, income statement and cash flow statement; depreciation and valuation techniques of assets; risk and uncertainly; linear programming - concept and approach**;** farm efficiency measures.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to farm management	
1.1	Definition, concept and nature of farm management	1
1.2	Importance and scope of farm management in Nepalese context	1
1.3	Relationship between farm management and other disciplines	1
2	Farm management decision making	
2.1	Strategic management and operational decisions	1
2.2	Administrative and marketing decisions	1
3	Principle involved in farm management decisions	
3.1	Law of equi-marginal return, opportunity cost principle and principle of comparative advantage	1
3.2	Factor substitution and combining enterprises	1
3.3	Cost, variable proportion and time comparison principle	1
4	Production relationships	
4.1	Factor-product relationship	

4.1.1	Concept of production function, average, marginal and total production and their relationships	1
4.1.2	Three zones of a classical production function	1
4.1.3	Increasing, constant and decreasing returns and economic decisions	1
4.1.4	Determining optimum level of input use and output produce with Cobb-Douglas production function analysis	1
4. 2	Factor-factor relationship	
4.2.1	Concept on factor-factor relationship, isoquant and iso-cost line, marginal rate of substitution, isoclines, expansion path and ridge lines	1
4.2.2	Types of factor-factor relationship (fixed proportion combination, increasing, constant and decreasing rates of substitution)	1
4.2.3	Least cost combination of two variable inputs (arithmetical, algebraic and graphic method)	1
4.3	Product-product relationship	
4.3.1	Concept on product-product relationship, production possibility curve, iso-revenue line and marginal rate of product substitution	1
4.3.2	Basic product relationships: joint, complementary, supplementary and competitive products as well as economic decisions in each case	1
4.3.3	Determination of optimum product combination (tabular, algebraic and graphic methods)	1
5.	Farm planning and budgeting	
5.1	Concept of farm planning and budgeting, its advantages and planning techniques	1
5.2	Characteristics of a good farm plan and steps of farm planning	1
5.3	Types of farm budgeting: partial, enterprise and complete budgeting	1
6.	Farm records and accounts	
6.1	Concept of farm records and accounts and their advantages; types of farm records: physical and financial records	1
6.2	Farm inventory: concept, advantages and process of taking inventory	1
6.3	Methods of valuation and depreciation calculation	1
6.4	Balance sheet, income statement and cash flow statement	1
7.	Farm efficiency measures	
7.1	Land use, production and labour use efficiency	1
7.2	Machinery, power and capital use efficiency	1
8.	Risk and uncertainty	
8.1	Concept and types of risk and uncertainty; different safeguard measures against risk and uncertainty	1
9.	Linear programming	
9.1	Linear programming: concept, definition and assumptions	1
9.2	Graphical method and dulality characteristics of linear programming	1
	Total	**30**

Practicals

S.N.	Topic	No. of practical
1	Rapport building on existing farming practices of different parts of Nepal	1
2	Profit maximization under input- output relationship	1
3	Determination of optimum combination of inputs	1
4	Determination of optimum combination of outputs	1
5	Preparation of physical farm records	1
6	Preparation of farm inventory	1
7	Preparation of balance sheet	1
8	Preparation of income statement	1
9	Preparation of partial budget	1
10	Preparation of enterprise budget	1
11	Valuation of farm assets using appropriate methods	1
12	Estimation of depreciation of durable farm assets using different methods	1
13	Exercise on linear programming	1
14	Assessment of agriculture risks and their safeguard measures	1
15	Measurement of farm efficiency: land use, production, labour and machinery use efficiency.	1
	Total	**15**

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Course Code : **AEC 211**

Course Title : **Natural Resource Economics**

Credit Hour : **2 (2+0) Full mark: 50 Theory: 50 Practical: 00**

Objectives

Upon the completion of this course, the students will be able to understand resources and its relation with economy as well as the environmental issues and management strategy related to agricultural development.

Syllabus

Introduction to natural resource economics; concept and categorization of natural resources; logistic growth and behavioral relationship of bio-mass; resource base of Nepalese economy - population, land, forest, water, mineral, climatic and livestock resources; concept of agri-environmental project cycle management, EIA and IEE; agri-environmental, natural resource and economic policies, action plans and conservation strategies; decentralization, public participation and public-private partnership in resource management; national legislation on protecting resources; key institutions involved in resource management; issues in use of specific resources; welfare economics, public goods, externality and valuation of non-tradable goods.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to natural resource economics	
1.1	Concept of natural resource economics, difference between natural resource economics and environmental economics, ecological economics and green economics	1
1.2	Relationship between agricultural/economic development and environment	1
2	Types of natural resources and its management	
2.1	Concept, definition, dimensions and types of natural resources	1
2.2	Renewable resource management: Behavioral relationship of biomass, ecological and economic optimum level of biomass	1
2.3	Gordon Schaefer's logistic growth model: Logistic steady state harvest of fish, optimal harvesting strategy, effort-harvest equilibria, maximum sustainable yield	1
2.4	Non-renewable resource management: Fossil fuel, crude oil, coal, natural gas, Nuclear fuel and their stock determination	1

2.5	Hotelling rule of optimal extraction	1
2.6	Population and natural resource relationship	1
3	Present situation, action plan and policies of resource management in Nepal	
3.1	Land resource and its use pattern, action plan and land distribution policy for its management	1
3.2	Forest resource, action plan and policy for forest and range land management	1
3.3	REDD++ and deforestation: concept, status, reasons and consequences	1
3.4	Water resource of Nepal and its importance, action plan and policy for watershed management	1
3.5	Watershed degradation, soil erosion and pollution	1
3.6	Mineral resources in Nepal, its use and problems	1
3.7	Climate and livestock resources of Nepal	1
3.8	Specific challenges for management of natural sources in Nepal	1
3.9	Species extinction and degradation of biodiversity	1
4	Concept of agri-environmental project and EIA and IEE	
4.1	Concept and aspects of agri-environmental project cycle management	1
4.2	EIA and IEE in agri-environmental projects: concept, importance and projects requiring EIA and IEE, process of implementing EIA in Nepal	1
5	Agri-environmental and economic policies and conservation strategies	
5.1	Agri-environmental policies: criteria and its need, key environmental policies in international as well as national level	1
5.2	Agri-environmental policies in recent National Agricultural Policy and Agriculture Development Strategy of Nepal	1
5.3	Economic policies on environment (carbon trade, polluter pay principle and taxation)	1
5.4	Concept of sustainability, SDG and sustainable resource conservation strategies	1
5.5	Key national and international institutions in resource conservation and management (objectives and important activities)	1
5.5	Decentralization and role of community for resource management, public-private partnership for resource management	1
6	Welfare economics, public goods, externality and valuation of non-tradable goods	
6.1	Definition of welfare economics and Pareto efficiency	1
6.2	Concept, types, measurement (direct and indirect methods) and internalization of externality	1
6.3	Concept and characteristics of public goods and its market failure	1
6.4	Valuation of non-tradable goods: concept, types and essence	1
6.6	Introduction to contingent valuation, hedonic regression and travel cost method	1
	Total	**30**

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Course Code : AEC 221

Course Title : Nepalese Agriculture Planning and Policies

Credit Hour : 2 (2+0) Full mark: 50 Theory: 50 Practical: 00

Objectives

Upon the completion of this course, students will know basic concepts of development economics and overall agricultural development development plans, policies, institutions and strategies.

Syllabus

Nepalese agriculture and economy - growth, characteristics and structure; factors of slow agricultural growth and development; development and policy related institutions in Nepal; present situation and trend of major crops and livestock production in Nepal; genesis of planned development and critical assessment of agricultural development plans; Nepalese agricultural development policies; poverty concept, measurements and poverty alleviation efforts in Nepal; food and nutrition security in Nepal; and foreign aid and investment in agriculture.

Outline

Theory

S.N.	Topic	No. of lecture
1	Nepalese agricultural development, its characteristics and structure	
1.1	Overview of Nepalese agriculture and economy	1
1.2	Characteristics of Nepalese economy and agricultural economy	1
1.3	Labour migration, remittance and its impact on agriculture	1
1.4	Role and importance of agriculture in Nepalese economy	1
1.5	Major components of Nepalese agriculture and their linkages	1
1.6	Critical assessment on cereals, cash crops, horticultural crops and livestock production	1
2	Factors of slow agricultural growth and development in Nepal	
2.1	Technical factors: supply and demand situation and institutional systems in production inputs (irrigation, fertilizers, seed, plant protection, mechanization, & technical backstopping)	1
2.2	Structural and institutional factors: land distribution and administrative (staff transfer, bureaucratic delays and fiscal year)	1
2.3	Socio-economic factors: risk aversion, cultural lags, agricultural credit, wage differential, market and price-based problems	1
3	Institutions involved in agricultural development in Nepal	
3.1	Government structure in relation to agricultural development	1
3.2	Objective, role and key activities of agriculture related ministries, departments, municipality and rural municipality, AKC, VHLSEC and service centres	1
3.3	Objective, role and key activities of semi-government institutions (NARC, DDC, NAST, AICL, STCL, Nepal Food Corporation, National Seed Company)	1
3.4	Objective, role and key activities of cooperatives and public-private partnership organizations	1
3.5	Objective, role and key activities of financial and private agencies (Nepal Rastra Bank, commercial and development banks, and Federation of Nepalese Chamber of Commerce and Industries)	1
4	Plans, policies and strategies for agricultural development in Nepal Periodic development plan	
4.1	History of planned development, planning cycle, development council, federal fiscal policy and process of development planning in Nepal	1
4.2	Critical assessments of 9^{th} and 10^{th} development plans (budget priority, poverty reduction strategy paper, macroeconomic and agricultural targeting *vs.* achievements, planned agri- programme, capital output ratio and key obstacles)	1

4.3	Critical assessments of very recent development plans (budget-wise development priority, macroeconomic and agricultural targeting *vs*. achievements, planned agri- programme, capital output ratio and key obstacles)	1
5	Long-term plans and strategies	
5.1	Mid-term expenditure framework practice in Nepal	1
5.2	Recent National Agricultural Development Policy (indicators, strategies and policies)	1
5.3	Agriculture Prospective Plan (context, objective, priority inputs and outputs and performance)	1
5.4	Agriculture Development Strategy: context, vision, strategies andprogram	1
5.5	Concept of super zone, zone, block and pocket development programme of Prime Minister Agriculture Modernization Project	1
5.6	Recent land tenure, land reform and land utilization policies in Nepal	1
5.7	Recent water resource management and irrigation policies in Nepal	1
6	Poverty and food security	
6.1	Definition, type and measurements of poverty	1
6.2	Poverty comparisons among SAARC and other developing countries	1
6.3	Poverty alleviation efforts of government, donors and INGOs in Nepal	1
6.4	Food and nutrition security analysis: definition, framework, current situation and coping strategies	1
7	Foreign aid and agricultural development	
7.1	Trend of foreign agricultural aid in Nepal	1
7.2	Importance and impact of foreign aid in agricultural development	1
	Total	**30**

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Course Code: AEC311

Course Title: Agriculture Marketing, Cooperatives and International Trade

Credit Hours: 3(2+1) Full Marks: 75 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, the student will be familiar with meaning, importance and types of agricultural markets, marketing functions and Nepal's domestic as well as international trade situation of agricultural commodities.

Syllabus

Introduction, meaning, scope, importance and problem of agricultural marketing; theory of firm, consumer's behavior elasticity and surplus; process of agricultural marketing, efficiencies, channel and supply chain; price determination, interventions; market plans and strategies development; market regulations, directives and extension; agricultural commodity market institutions and marketing in Nepal and South Asia; role of cooperative in agricultural marketing; and concept, importance and types of trade and trade competitiveness as well as trade position of Nepal.

Outline

Theory

S.N.	Topic	No of Lecture
1	Concept, meaning, scope, importance and problem of agri-marketing	
1.1	Definitions and concepts of agricultural market and marketing, marketing vs selling approach, marketable and marketed surplus and market intermediaries	1
1.2	Scope, importance and problems of agricultural marketing in Nepal	1
2	Theory of firm, consumer's behaviour, elasticity and surplus	
2.1	Theory of firm: production, cost and supply functions with their relations and derivation, theory of consumer behavior and equilibrium	1
2.2	Consumers' and producers' surplus	1
2.3	Market elasticity: Demand and supply elasticity and their estimation techniques	1
3	Process of agricultural marketing, efficiencies, channel and supply chain	
3.1	Marketing functions: definition, brief description of primary, secondary and tertiary functions as well as exchange, physical, facilitating and risk bearing function	1
3.2	Marketing efficiencies: technical, operational and price efficiencies	1

3.3	Price spread and general marketing channels of major crops and livestock products	1
3.4	Supply chain management: concepts, definition, importance and coordinated supply chain management	1
4	Price discrimination, variation and government intervention	
4.1	Price discrimination - concept, assumptions, explanation and degrees	1
4.2	Spatial and temporal price variation, market integration - meaning and types, and regional equilibrium models	1
4.3	Government intervention in agricultural marketing– concept, objectives and tools	1
5	Market plans and strategies development	
5.1	Market oriented production plan and strategy development technique	1
5.2	Marketing mix, market for poor (M4P) strategies	1
6	Marketing research, market information system and extension	
6.1	Definitions, importance and types of marketing research and marketing intelligence, market information system (MIS) - concept and importance	1
6.2	Marketing extension and infrastructure: physical and social infrastructure and their dissemination process	1
7	Agricultural commodity market and marketing in Nepal	
7.1	Marketing acts, rules, directives & legislations related to agricultural product market establishments, infrastructures and marketing	1
7.2	Cereals seed marketing situation, formal marketing, prices fixation and outlets	1
7.3	Vegetable and fruit marketing system: channel, price spread and outlets	1
7.4	Livestock and dairy products: marketing channel, price spread and outlets	1
7.5	High value commodities (ginger, sugarcane, honey, lentil, cardamom, coffee, tea: marketing channel, value addition, price spread and outlets)	1
8.	Cooperatives	
8.1	Concepts, history, objectives, principles, types, importance, and laws of cooperative and agricultural cooperatives	1
8.2	Agricultural cooperatives in Nepal, and their role in production value	1
8.3	addition, and marketing Fair trade, buy-back and contrat marketing	1
9	International trade	
9.1	Concept, definition, importance and types of international trade	1
9.3	Trade gains, barriers to trade (tariff and non-tariff) and basis for international trade	1
9.4	Concept of trade liberalization, privatization and globalization	1
9.5	Global environment to trade –WTO, GATT, IPPC, OIE, GAT, GATS, CoDEX, ASIAN, EU, BIMSTEC, SAPTA and SAFTA	1

9.6	Nepal Trade Integration Strategy (NTIS) and Agreement on Agriculture (AoA)	1
9.7	Balance of payments and balance of trade concepts and situation of Nepal	1
	Total	**30**

Practical

S.N	Topics	No of practical
1	Major institutions related to agricultural product markets in Nepal & SAARC	1
2	Estimate production and marketing cost of high value product at various chain level	1
3	Excursion of nearby wholesale agriculture market and understand market-oriented products, supply, demand and pricing mechanism	1
4	Fixed and auction based price system in wholesale market	1
5	Collect data of price and quantity (and quality) relationship of agri-product from nearest retail or wholesale markets for a month period	1
6	Indexing of past wholesale and retail prices of agricultural crops	1
7	Presentation of demand and supply schedule preparation from market study	1
8	Preparation of supply chain of high value crop/livestock and calculate price spreads, producer's share and marketing cost at different stages of channel	1
9	Study on various marketing functions operated by the market intermediaries (collector, trader, processor)	1
10	Study on contact marketing system, buy-back and pricing arrangement of agricultural commodity (for example: orange, seed, chicken, coffee etc)	1
11	Prepare marketing plan of agricultural commodity	1
12	Case study of organizational structure, marketing structure, marketing information systems and marketing management of agricultural cooperatives in local (rural/municipal) level	1
13	Study on Nepal's trade policies, their merits and shortfalls	1
14	Critical analysis of Nepals' BOP situation in recent years	1
15	Study on government intervention tools for price stabilization	1
	Total	**15**

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Pandey M. and Tewari, D. 2010. The agribusiness book: marketing and value chain prospective. IBDC Publisher, New Delhi, India.

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Course Code : AEC 321

Course Title : Agriculure Project Planning and Management

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, the students will be able to understand need based project planning for agricultural research and development, apply the widely used tools in agricultural project management and research.

Syllabus

Method of planning tool, their utilities and limitations; Feasibility study of new project: Need assessment of beneficiaries, SWOT analysis; Agricultural project cycle, aspects, appraisal, and analysis; Logical framework and its components; Sustainable Livelihood Approach (SLA): concept, definition, framework and various elements; Scientific project proposal and report writing knowledge and skill.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to project planning tools, their utilities and limitations	
1.1	Basic concepts of project and different project planning tools	1
1.2	Project cycle: concept and phases	1
1.3	Need assessment: problem identification and prioritization	1

1.4	Feasibility study: concept and types	1
1.5	ZOPP approach of project planning	1
1.6	Concept of Participatory Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project management	1
2	Project preparation and analysis	
2.1	Technical, commercial and financial aspects of project preparation and analysis	1
2.2	Economical, social and environmental aspects of project preparation and analysis	1
2.3	Project appraisal criteria: discounted methods, their merits and limitations	1
2.4	Project appraisal criteria: non-discounted methods, their merits and limitations	1
2.5	Project monitoring and evaluation: concept, aims, indicators and steps	1
2.6	Sensitivity analysis: concept, importance and method	1
3	Development of research and development projects	
3.1	Concept, function, importance and types of proposal	1
3.2	Development of project concept note and full proposal for research projects	1
3.3	Development of project concept note and full proposal for development projects	1
3.4	Development of logical framework for research and development projects	1
4	Socio-economic research methods	
4.1	Concept and types of socio-economic researches	1
4.2	Socio-economic research process	1
4.3	Research gap, research questions and hypothesis formulation and testing	1
4.4	Sampling techniques: probability and non-probability sampling	1
4.5	Questionnaire preparation for agricultural research	1
5	Report writing and seminar presentation	
5.1	Elements and technique of a technical report writing	1
5.2	Data presentation methods: tables and graphs	1
5.3	Data presentation methods: charts, diagrams, maps and pictures	1
5.4	Acronyms, abbreviations, foot notes and appendices	1
5.5	Abstract writing in scientific reports	1
5.6	Summary and conclusion writing in scientific reports	1
5.7	Seminar presentation of research findings	1
6	Referencing	
6.1	Concept and importance of referencing and bibliography	1
6.2	Referring techniques in the body and end of the technical reports	1
	Total	**30**

Practical

S.N.	Topic	No of practical
1	Problem identification and prioritization exercise	1
2	ZOPP: problem tree and objective tree analysis exercise	1
3	PCN writing for research projects and development projects	1
4	Log frame preparation for research and development projects	1
5	Use of appraisal criteria for investment analysis (NPV, IRR and B/C Ratio and pay-back period)	1
6	Analysis of break-even point (BEP) and return on investment (ROI)	1
7	Sensitivity analysis of agricultural projects	1
8	Questionnaire preparation for socio-economic research	1
9	Data collection exercise (household survey)	1
10	Data collection by FGD and KII	1
11	Preparation of seminar presentation material	1
12	Use of different data presentation methods	1
13	Preparation of technical report	1
14	Referencing in body as well as at the end of the report	1
15	Use of SPSS on data entry and analysis	1
	Total	**15**

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Course Code : AEC 411

Course Title : Agribusiness Management and Financing

Credit Hour : 3 (2+1) Full Mark: 50 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, the students will be able to know meaning and importance of agribusiness management, business organization forms, marketing and international trade, financial auditing and appraisal. Students will also get field-based knowledge and skills on value chain analysis and business plan development.

Syllabus

Introduction, importance, scope of agribusiness management; Basic concept; Financial management of agribusiness organizations; Agri-business status, feasibilities, appraisals and forms of business organization; Entrepreneurship development in agriculture; Business decision, human behavior and management functions; Agri-business ethics, food safety and business leadership; Agri-business and financial risk management; Plan, policies and strategies in agribusiness and financial management; Value chain approach in agribusiness and financial management.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to agribusiness	
1.1	Concepts on business, agribusiness, management, agribusiness management, trade, commerce, incubation, inclusive business, firm, plant and industry and interrelationship between firm, plant and industry	1
1.2	Introduction to enterprise, entrepreneur and entrepreneurship	1
1.3	Definition, importance and distinctive features of agribusiness	1
1.4	Present situation, problems and prospects of agribusiness in Nepal	1
2	Agribusiness enabling environment and business feasibility	
2.1	Business enabling environments	1
2.2	Institutions involved in agribusiness promotion in Nepal	1
2.3	National agribusiness policy 2006; crop and livestock insurance policy and agribusiness lending policies	1
2.4	Feasibility analysis of agricultural business – concept and types, five-force model of business attractiveness	1
2.5	Concept and assessment framework of Innovation Development Early Assessment System (IDEAS)	1

2.6	SWOT analysis of agribusiness	1
2.7	Investment appraisal techniques (B/C ratio, FRR, NPV, profitability index, PBP, break-even analysis) and return on investment (ROT) on business feasibility analysis	1
3	Business plan	
3.1	Concept, definition, steps and importance of business plan preparation	1
3.2	Elements (framework) of business plan report	1
4	Organizational behaviour and decision making in agribusiness	
4.1	Concept of organization, interpersonal behaviour and their determinants	1
4.2	Concept of management, management system and management functions, level of management, attributes of good management	1
4.3	Steps and tools of agribusiness management (farm inventory, balance sheet, income statement and cash flow statement)	1
4.4	Basic economic principles involved in agribusiness management	1
4.5	Strategic management in agribusiness	1
4.6	Forms of business organization (sole proprietorship, partnership, corporation, limited liability and joint venture, second tire organization, and public private partnership)	1
5	Financial management in agri-business	
5.1	Planning for capital needs (fixed, working, and growth capital equity *vs*. debt capital) and capital budgeting	1
5.2	Agribusiness financing, financial intermediation and intermediaries in agricultural, role of credit in agribusiness	1
5.3	Credit policies and legal requirements for loan from formal sources	1
6	Agribusiness leadership and motivation	
6.1	Concept, characteristics and styles of leadership, leadership emergence	1
6.2	Concept, nature and factors of business motivation; Maslow's hierarchy of needs theory of motivation	1
7	Risk management in agri-business	
7.1	Concept and types of business risks, risk-return trade-off, and risk behaviour of entrepreneurs, risk premium and hedging	1
7.2	Use of decision tree and probability tree in risk analysis	1
7.3	Business risk management steps and strategies for risk management (farm-based, market- based and post-market policies)	1
8	Value chain approach in agribusiness	
8.1	Concept, elements and importance of value chain	1
8.2	Sub-sector analysis technique in value chain, value chain mapping	1
9	Business ethics and social responsibility	
9.1	Concept and essence of business ethics and social responsibility	1
	Total	**30**

Practical

S.N.	Topic	No of practical
1	Study on five forces of competition and business feasibilities of high value commodity	1
2	Conduct farmer's business school to the nearby famers group / cooperatives on particular commodity	1
3	Visit of nearest agribusiness lead firm, company or cooperatives to study registration process, management structure, business size, investment and profitability situation of high value commodity	1
4	Study on business cycle of agro-industrial commodities	1
5	Study about income statement, balance sheet and financial ratios	1
6	Study on nearby bank and study their loan provisioning status and viability of loan in agricultural business	1
7	Study on commodity-based business associations in Nepal	1
8	Study on sub-sector analysis and value chain selection process	1
9	Actor mapping, linkage (forward and backward) and chain functions in value chain analysis	1
10	Value chain mapping tool box and chain development	1
11	Steps of production plan preparation	1
12	Price and cost estimation in business plan	1
13	Preparation of marketing plan and operation plan	1
14	Preparation of financial appraisal by discounted and non-discounted methods (NPV, IRR, B/C Ratio, ROI, BEP, PBP)	1
15	Study on major business risks and safeguard measures	1
	Total	**15**

References

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MOALD. 2012. Agri-insurance policy. MoALD, Kathmandu, Nepal.

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Reddy, S.S. and P. Raghuram. 2000. Agricultural finance and management. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.

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3.3 Agricultural Extension And Rural Sociology

Course Code : EXT 111

Course Title : Fundamentals of Rural Sociology and Educational Psychology

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

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.

Syllabus

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 and culture concepts. Rural-social institutions, social problems and their solution, socialization, social change, social system, social deviance, and social control. Leadership, Educational psychology-Meaning, Concept; Education, learning: Learning theories, Basic Psychological concepts; motivation, Emotions, Attitudes and Perception.

Outline

Theory

S.N.	Topic	No. of lecture
1	Rural sociology: meaning, nature, scope, importance in Nepalese context and relationship with agricultural extension and other social sciences	1
2	Social values and attitude: meaning, definition, types and role of social values and attitudes in agricultural extension	1
3	Nepalese rural society: characteristics; cultural concepts, culture, customs, folkways, mores, taboos, rituals and traditions: meaning, definition and their role in agricultural extension.	1
4	Rural – urban continuum: concept, differences and relationship between rural and urban societies	1
5	Social groups: meaning and definition, and classification of groups	1
6	Factors considered in formation and organization of groups, stages of group formation, role of social groups in agricultural extension	1
7	Social process (process of social interaction): basic concepts; accommodation, adjustment, amalgamation, assimilation, cooperation, consensus, competition, conflict and integration	1

8	Conflict: stages, conflict intensity continuum and conflict management	1
9	Social movement: meaning and causes of social movement, early and recent theories and types of social movement	1
10	Social stratification: meaning, bases (class, caste, age and gender), viewpoints on stratification: functional, Marx and Max weber	1
11	Social stratification and inequality, caste/ethnic and regional exclusion in Nepal	1
12	Rural-social institutions: concept and functions:	
12.1	Social institutions: household, family and its types, and marriage system	1
12.2	Economic institutions: farming, fishing, hunting and exchange labor	1
12.3	Educational institution; political institutions: government; religious institutions: types of religion, their maintenance and followers	1
13	Social problems and solutions	1
14	Socialization: meaning, stages and agents of socialization	1
15	Overview of theories of socialization/self by Cooley, Mead and Freud	1
16	Social change; meaning and factors of social change	1
17	Agricultural technology and rural social change	1
18	Social system: meaning and elements of social system	1
19	Social deviance and social control; meaning, types and mechanisms	1
20	Leadership: meaning, classification, function and role of local farm leader in agricultural development and 21 qualities of good leader	1
21	Education, psychology, educational psychology, social psychology: definitions and importance in agricultural extension	1
22	Basic principles of human behavior: sensation, attention, perception: meaning and characteristics. Basic concept of change in the behavior: knowledge, skills & attitudes. Characteristics & differences between formal, non-formal & informal education	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: four learning theories and Thorndike's four laws of learning	1
25	Effective teaching learning elements. Factors affecting effective teaching learning situation	1
26	Basic psychological concepts; intelligence, personality, motivation, emotions, attitudes and perception	1
27	Personality: traits, types & measurement; factors influencing the personality. Motivation: significance, techniques; perception: determinants, errors; attitudes: factors influencing the development of attitudes	1
28	Roles of personality, motivation, attitudes and perceptions in agricultural extension	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Visit to a village 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. Working of basic rural institutions (group exercise)	2
3.	Visit to a village to conduct the selection of a leader (based on sociogram technique) (group exercise).	1
4.	Visit to a rural community to identify different social groups to which the farmers are associated	1
5.	List out the taboos, folkways, rituals, and social values in the village	1
6.	Preparation of interview schedule to study the social characteristics of rural society: pattern of settlement, culture, social stratification, social values, social control, customs, social interaction process, social change and social problems (group exercise)	1
7.	Identification of important value systems in the rural setting as a means of social control	1
8.	Identification of rural personality traits that affect the development of personality in rural situation	1
9.	Conducting role play technique by the students to exhibit different leadership styles (group exercise)	2
10.	Creating a learning situation under village conditions. Visit to a village to organize an exhibition for farmers (group exercise)	2
11.	Practice on personality and intelligence measurement techniques (group exercise)	2
	Total	**15**

References

Bhushan, V. and D.R. Sachdeva. 2000. An introduction to sociology. Kitab Mahal, India.

Chitambar, J.B. 2015. Introductory rural sociology. New Age International Publishers, India

Gisbert, P. 2010. Fundamental of sociology. Orient Blackswan, New Delhi.

Rao, U. 2015. Advanced educational psychology. Himalaya Publishing House, New Delhi.

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Course Code : EXT 311

Course Title : Fundamentals of Agricultural Extension

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

The main objective of this course is to develop student's ability on basic concepts of different types and forms of education, their philosophy, principles, objectives processes and practices.

Syllabus

Concept and definition of education, extension education; scope, function and role of agricultural extension in agricultural and rural development. Concept of learning, learning theories, teaching learning elements, teaching methods, innovation, type and nature of innovation, concept of adoption, type of adoption decision, innovation decision; classification and types of leadership styles, research and extension linkage system, types of traditional to recent models of TOT; concept and types of leader and leadership, concept of program planning, planning tools and techniques, supervision, monitoring and evaluation, and land grant college (LGC).

Outline

Theory

S.N.	Topic	No. of lecture
1.	Objectives of the course & syllabus: its relation with agricultural extension and concept of extension education. Basic elements and characteristics of extension education. Level of extension: extension education and extension service	1
2	Scope & function of agricultural extension in agriculture & rural development. Philosophy & principles of extension education	1
3.	Historical events of agriculture extension in the world. Major historical changes & emerging issues of extension service in Nepal	1
4.	Concept of training: differences between education, training and learning. Approach, type and cycle of training	1
5.	Phase of training: pre-training, training and post training	1
6	Concept of entrepreneurs, entrepreneurship and entrepreneurial behavior. Typology of entrepreneurs in the context of agriculture	1

7	Theories of entrepreneurs: Schumpter, classical, neo classical and axiomatic	1
8	Model of entrepreneurship. Factors affecting entrepreneurship	1
9.	Concept and meaning of extension teaching methods and classification of teaching methods	1
10.	Selection and use of teaching methods. Edger cone of experiences and use of teaching methods	1
11.	Concept of innovation, type and nature of innovation, adoption and diffusion. Concept of adoption and type of adoption decision	1
12.	Process of innovation decision and steps of innovation decision	1
13.	Adopters categories and its characteristics. Factors affecting diffusion of an innovation	1
14.	Concept of technology and agriculture technology and its types. Concept of technology transfer (ToT)	1
15	Function of technology generation, development and dissemination. Agriculture technology transfer process and steps	1
16	Research & extension linkage system: why extension system is necessary ?	1
17	Different types of traditional to recent models of ToT	1
18.	Concept of leader and leadership: differences between a leader and a manager. Characteristics and elements of leadership	1
19	Theories of leadership: trait theories, behavioral theories and fielder model. Hersey and Blanchard model and path goal theory	1
20	Classification and types of leadership styles. Leadership development model: capability model. Methods of identification of local leaders	1
21.	Concept of program, planning & program planning of extension program. Concept of goal and objectives of extension program, types of agricultural plan. Principles of program planning. Level & functions of program planning	1
22.	Steps of program planning. Modern tools for analysis of situation: SWOT analysis. Identify the problems and needs: setting the objectives of the program	1
23	Develop a plan of work: log frame preparation for program planning	1
24.	GoN practice of program planning in agriculture. Participatory and bottom up program planning in agriculture	1
25	Agriculture program planning process in rural municipality, municipality and the state: structure and process	1
26.	Basic concept and differences between supervision, monitoring and evaluation. Monitoring & evaluation indicators: input, process, output & impact indicators	1
27	Situation and approaches and type of agriculture program evaluation	1

28	Basic steps of evaluation program: development of evaluation plan	1
29	Participatory monitoring and evaluation Tools of participatory monitoring and evaluation	1
30	Concept of Land Grant College (LGC) in USA and in the world. Development events of LGC: Moril Act, Hatch Act and Smith level Act. Role & functions of agricultural universities/agricultural colleges in development	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Conduct participant observations	1
2	Understand group dynamics and facilitation of group meeting	1
3	Conduct need assessment	1
4	Prioritize needs and problems	1
5	Conduct SWOT analysis	1
6	Conduct or participate farmers field school (FFS)/farmers training	1
7	Develop an extension plan on 4x4 logical framework	1
8	Visit to ASC/LSC and observation of planning process	1
9	Visit to development agency and study their planning process	1
10	Organize or/and participate in a agriculture extension campaign	1
11	Conduct methods/result demonstrations	1
12	Visit to farmers group & study their program planning process developed by government agencies	1
13	Visit to farmers group & study their program planning process developed by development agencies	1
14.	Preparation of evaluation plan	1
15.	Write extension program/events/evaluation reports and share the results	1
	Total	**15**

References

Dongol, B.B.S. 2015. Extension Education (2nd edition), Prativa Dangol, Kathmandu Nepal.

Jaishi, M.B., K. Bishwakarma and L. Shahi. 2015. Fundamentals of extension education: A practical manual for undergraduate students. Mahesh Jaishi, Kathmandu, Nepal.

Ray, G. L. 2011. Extension communication and management. Kalyanipublishers.

Subedi, M. and M. Kaplowitz. 2016. What every extension worker should know? USAID/Michigan State University and MEAS, USA.

Swanon, B.E., R.P. Bentz and A.J. Sofranko. 1996. Improving agricultural extension: A reference manual, Daya Publisher House Delhi.

Course Code : EXT 321

Course Title : Agricultural Communication

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objective

The main objective of this course is to develop knowledge and skills of students on communication, its concept, process, models, theory, forms, system and its use in agriculture by planning and strategy development. This course also helps students to develop ability on using various ICT tools, indigenous tools and research design in agriculture development.

Syllabus

Communication: concept, principles, process, models, theories, barriers of extension and communication. Forms of communication, system, feedback in communication, communication channel, organizational communication, communication planning, strategy, policies, approaches, agriculture knowledge information system, information and communication technology (ICT). Tools, social media, mass media, web technology, application of ICT in agriculture, research in communication and communication of indigenous knowledge in agriculture development.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Concept of communication (meaning, definition, scope, importance & function)	1
2.	Principles of effective communication	1
3.	Communication in agriculture and development	1
4.	Communication as a process: nine elements of communication	1
5	Extension and communication	1
6.	Models of communication: meaning and concept (Aristotle, Sachramm's, Shannon and Weaver, Berlo's, Leagan's, and Roger's)	1
7.	Theories of communication: meaning, concept and importance. Linguistic, Individual Difference, Social Categories and Social Relationship.	1
8.	Hypodermic Needle Theory, Two Step Theory, Agenda Setting Theory, Cultivation Theory and Cognitive Dissonance Theory	1

9.	Forms of communication: meaning, concept and types. Verbal and written communication: concept, types and importance	1
10.	Nonverbal communication	1
11.	Barriers of communication: types of barriers and strategy to overcome	1
12.	Individual system of communication: concept, types, function, importance, and limitation	1
13.	Group system of communication: concept, types, function, importance and limitation	1
14.	Mass system of communication: concept, types, function, importance and limitation	1
15.	Feedback: definition, characteristics, role, effect and importance	1
16.	Communication channel: concept, types and selection of communication channel	
17.	Skills for effective communication	1
18.	Organizational communication	1
19.	Communication planning for agricultural development	1
20.	Communication strategy for agricultural development	1
21.	Overview of communication related policy and media of Nepal	1
22.	Communication approaches of GoN in agriculture sector	1
23.	Communication approaches of development agencies: cooperatives and private	1
24.	Agriculture knowledge information system	1
25.	Concept of information and communication technology (ICT)	1
26.	ICT Tools: printed media, electronic media, multimedia mobile phone and video	1
27.	Use and importance of social media, mass media and web technology	1
28.	Application of ICT in Agriculture	1
29.	Communication research for agricultural development	1
30.	Role of indigenous knowledge and communication in agriculture development	1
	Total:	**30**

Practical

S.N.	Topic	No. of practical
1.	Preparation of printed materials (poster,)	1
2.	Preparation of printed materials (booklet and leaflet)	1
3.	Preparation of organizational chart	1
4.	Preparation of charts (problem tree, flip, flow and organizational)	1
5.	Field report writing and presentation	1

6.	Preparation and conducting drama (indigenous media)	1
7.	Preparation and presentation of photo stories	1
8.	Preparation of newsletter	1
9.	Communication proposal development	1
10.	Proposal seminar (communication)	1
11.	Designing agriculture campaign	1
12.	Conducting agriculture campaign	1
13.	Writing and presentation of local songs, TV program	1
14.	Development of presentation skill	1
15.	Preparation and presentation of skill development through Microsoft power point	1
	Total	**15**

References

Dahama, O.P. and O.P. Bhatnagar. 2009. Education and communication for development. Oxford and IBH publishing company pvt. Ltd. New Delhi, India.

Dubey, V.K. and I. Bishnoi. 2009. Extension education and communication. New Age International Publishers, New Delhi, India.

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Robbins, S.P., T.A. Judge and S. Sanghi. 2009. Organizational behavior. Printice Hall, India.

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Course Code : EXT 411

Course Title : Social Mobilization and Community Development

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

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.

Syllabus

Concept of development, development indicators, dimension, theories, trends, approach and its characteristics. 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 and social

mobilization. Decentralization for development: practice, strategies and issues in Nepal, gender concept and terminologies, concept of migration, remittance use in agriculture, and gender implication of migration. Social mobilization: concept, history, process, typologies, stage and challenges. Participatory planning in social mobilization process, monitoring and evaluation, participatory learning and action tools.

Outline

Theory

S.N.	Topic	No. of lecture
1	Concept of development: development characteristics, indicators and dimension. Differences between change, growth and development	1
2	Overviews of development theories: economic and non-economic theories of development	1
3	Overview of approach, trends & development practice of Nepal	1
4	Concept of modernization: overview of modernization theory. Rostow's model of economic development and 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 & procedure. Guiding principle and type of community development program	1
7	Basic values and 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. Forms of decentralization and brief history of decentralization practice in Nepal	1
10	Overview of local government reforms & federalization in Nepal	1
11	Major characteristics of current decentralization practice of Nepal. Advantages, disadvantages and issues of decentralization practice in Nepal	1
12	Concept of sex and gender, gender stereotypes, gender roles and gender need. Social stratification and gender and gender based discrimination in Nepal. Concept of equity and equality	1
13	Gender analysis and guiding question, gender analysis tools. Gender sensitive planning and gender budgeting. Gender mainstreaming: process and procedure, and 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 & remittance status. Migration & 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, and major portfolio of planning	1
24	Major activities of program planning of social mobilization. Fundamental question preparation before planning and steps 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 & techniques of PRA/ RRA used in social mobilization process	1
27	Observation & analysis: participants observation, transect walk, trend analysis and livelihood analysis	1
28	Matrix and ranking: wealth being ranking, priority matrix, problems matrix, direct matrix ranking and pair wise ranking	
29	Discussion and interview: focused group discussion and semi-structure interview	1
30	Diagram and mapping: resource mapping, venn diagram, social mapping, mobility map, activity profile, problem solving tree and seasonal calendar	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Visit DDC/municipality/rural municipality and study social mobilization process	1
2	Study of resource mobilization/social mobilization guideline 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 & techniques of PRA/RRA used in social mobilization process. Selection of appropriate tools of participatory learning and action	1
6	Conduct transect walk, night halt in a community and prepare report	1
7	Conduct wealth being ranking and conduct 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 mobility map for any one of the tasks/events most people follow	1
12	Conduct FGD and prepare problem tree/problem solving tree	1
13	Conduct stakeholders analysis with response to implement any community development program	1
14	Preparation of Venn diagram and institution mapping	1
15	Conduct gender analysis by using any gender analysis tools	1
	Total	**15**

References

Chambers, R. 2016. Revolution in development enquiry (Nepal edition). Earthscan, New York.

Khan, S. S. and J.S. Sah. 2001. Social mobilization manual based on Synaja experiences. Social mobilization experimentation and learning center.

Ministry of Local Development. 2068 BS. Village development committee: social mobilization guideline.

3.4 Agronomy

Course Code : AGR 111

Course Title : Principles of Agronomy

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

The main objective of this course is to provide students with basic concepts, knowledge and skills on the principles behind the practices of crop production.

Syllabus

Definition, concept and evolution of agriculture and agronomy, their relationship with other disciplines, food situation in Nepal and issues of food security, crops and their classification, crops and climate, tillage, seed, cropping systems and farming systems, cropping pattern and crop rotation, concept of ideal plant type and crop yield, optimum plant population, crop geometry and cropping density, soil fertility and productivity, agronomical practices for soil fertility and crop productivity maintenance, crop nutrition, fertilizers and manures, organic manures and bio-fertilizers, weed management, plant and soil water relationship, importance of irrigation and drainage systems, soil erosion and soil conservation, rainfed farming and water harvesting, recent advances in agronomy and issues of sustainability in agriculture.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Overview of agriculture and agronomy	
1.1	Definition of agriculture, multidisciplinary nature of agriculture, evolution of agricultural systems, crop and agronomy, green revolution, ecological agriculture, scope and role of agronomy and retrospect of Nepalese agriculture	1
1.2	Status of Nepalese farmers, farming practices in different agro-ecological zones and our journey in agriculture	1
1.3	Definition of food and food security, major problems of Nepalese agriculture, and role of agronomist in solving food problems in Nepal	1
1.4	Phyto-geography and agriculture heritage in Nepal	1
2	Weather and climate	

2.1	Definition of weather, climate, meteorology, agro-meteorology, major elements of climate, importance, need and scope of climate in Nepal	1
2.2	Agro-climatic zones of Nepal, effect of temperature on biochemical reaction, photosynthesis, respiration, growth and growth duration of crops and concept of growing degree days	1
2.3	Solar radiation, its photosynthetic, photoperiodic, thermal and other effects on crop growth, development and yield	1
2.4	Precipitation and its effect on crop production, land classification based on precipitation, relative humidity, wind and their effect on crop growth, development and yield	1
3	Tillage	
3.1	Definition of tillage, brief history and objectives of tillage, types of tillage, advantages and disadvantages of conventional and conservation tillage	1
3.2	Definition of primary, secondary and inter-tillage, important tools, equipments and machines used for tillage	1
4.	Seed and sowing	
4.1	Definition of seed, grain, seed technology, characteristics and importance of quality seed	1
4.2	Classes of seed, methods of sowing, factors involved in sowing management	1
5.	Cropping system	
5.1	Definition, cropping pattern, sole cropping, multiple cropping, intercropping, mixed cropping, relay cropping and crop rotation, cropping index, cropping intensity, and land equivalent ratio	1
5.2	Cropping systems by seasons in Nepal, characteristics of seasons, agronomic concepts of the growing seasons, effect of season on choice of crops, and efficient crop zone	1
6.	Plant type and plant population	
6.1	Concept of ideal crop, plant type and yield, cropping density, optimum plant population, crop geometry and their importance	1
7.	Soil fertility and productivity	
7.1	Definitions and differences, major soils of Nepal (alluvial soils, black soils and red soils) and problematic (saline and alkaline soils)	1
7.2	Elements in plant nutrition, classification of essential elements, forms of elements absorbed by plants (nutrients), soil productivity constraints, nutrient deficiency and toxicity	1

7.3	Organic manures and their importance, FYM, compost, vermicompost, night soil, sewage and sludge, biogas slurry, oil seed cakes and green manures	1
7.4	Chemical fertilizers and their role in crop production, nitrogenous, phosphatic and potassic fertilizers, and micronutrient supplements available in Nepal	1
7.5	Biofertilizers and their importance, types, factors affecting fertilizer use, limitation of organic manures, green manures and green leaf manures, bio-fertilizer and chemical fertilizers available in Nepal	1
8.	Weed management	
8.1	Definition of weed, classification, beneficial and harmful effects of weeds	1
8.2	Mode of weed seed dispersal, concept of weed management: preventive and curative (physical, chemical, biological and chemical) methods, relative merits and demerits of different methods	1
9.	Irrigation and drainage	
9.1	Definition of irrigation, importance of irrigation to crops, water movement in soil-plant–atmospheric system, and water use efficiency	1
9.2	Methods of irrigation: surface and subsurface methods (gravity irrigation, tank irrigation and lift irrigation) with their advantages and disadvantages	1
9.3	Irrigation scheduling, estimation of soil moisture constants, and irrigation management under limited water supply.	1
9.4	Drainage: definition and objectives of drainage, types of drainage, adverse effect of water logging, and method of improving soil drainage system.	1
10.	Soil erosion	
10.1	Definition of soil erosion, types of soil erosion based on erosive agents, water erosion and its types, factors affecting water erosion, water erosion in Nepal	1
10.2	Wind erosion and its types, factors affecting wind erosion, wind erosion in Nepal, and measures taken against water and wind erosion in Nepal	1
11	Rainfed farming and water harvesting technology	
11.1	Rainfed farming: difference between dry land farming and rainfed farming, importance of rainfed farming in Nepal, management of farming under moisture stress condition, water harvesting	1
11.2	Recent trends and advances in agronomy and issues of agricultural sustainability in Nepal	1
	Total	30

Practical

S.N.	Topic	No. of practical
1.	Visit to the Agronomy Farm and laboratories of the campus	1
2.	Identification of the seeds of field crops, fertilizers, manures and pesticides	1
3.	Introduction to the tillage implements and practice on their use	1
4.	Understanding seeding practices and working with seeding imlements	1
5.	Calculation of the amount of fertilizers based on recommended dose and nutrient content	1
6.	Calculation of cropping index, cropping intensity, land equivalent ratio (LER), and land use efficiency (LUE)	1
7.	Calculation of soil moisture constants, and water use/irrigation efficiency	1
8.	Practice on the preparation of FYM and compost by different methods	1
9.	Practices on vermicompost, green manures and bio-fertilizers and their applicability	1
10.	Identification of the major weeds of field crops and preparation of herbarium	1
11.	Identification and practice on the use of various agro-meteorological devices	1
12.	Maturity judgment and yield estimation of major field crops	1
13.	Formulation of pesticides and practices on their application	1
14.	Practice on seed treatment with different pesticides	1
15.	Introduction to national and international crop research and development organizations	1
	Total	**15**

References

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Bhattacharya, B. 2009. Advanced principles and practices of agronomy. Kalyani Publishers, India.

Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2010. A textbook of agronomy. New Age International (P) Limited, Publishers. New Delhi, India.

Nandeha, K. L. 2015. Agronomy. Today & Tomorrow's Printers and Publishers, New Delhi

Reddy, S.R. 2010. Principles of agronomy. Kalyani Publishers, New Delhi.

Course Code : **AGR 121**

Course Title : **Agronomy of Cereal Crops**

Credit Hour : **3 (2+1) Full Marks: 75 Theory: 50 Practical: 25**

Objectives

The main objective of this course is to provide knowledge and skills at improved package of cultivation practices for common cereal crops in Nepal.

Syllabus

Status of cereal crops in Nepal, introduction, importance, origin, history, distribution, ecology, morphology, place in cropping systems, varieties, and improved package of practices: land preparation, fertilizer, irrigation, weed management, harvesting, threshing, storage of rice, maize, wheat, finger millet,, barley, buckwheat, triticale and minor millets with recent trend on research and advances in these crops.

Outline

Theory

S. N.	Topic	No. of lecture
1	Perspectives of cereal crops in Nepal	1
1.1	Introduction, importance, production status, problems including yield gaps and opportunities of cereal production in Nepal	1
2	Importance, ecology and agronomy of rice crop	
2.1	Introduction and significance of rice in the world and in Nepalese economy; area, production, distribution, productivity and culture associated with rice	1
2.2	History and origin, classification, phonology, seed dormancy, reasons of lower yields of rice in tropical than the temperate regions	1
2.3	Ecology of rice crop: solar radiation, temperature, rainfall, wind velocity, relative humidity, altitude and latitude and soil requirements	1
2.4	Rice cultivation systems: upland and aerobic rice cultivation practices: Land preparation, seed rate, seed treatment, methods of sowing, manure and fertilizer requirements, weed and water management practices, recommended varieties, harvesting, threshing, cleaning, yield and storage	1
2.5	Lowland rice cultivation practices: Seed rate, seed treatment, raising rice nursery by various methods including dry bed nursery, wet bed nursery, dapog and modified dapog, and nurseries for mechanical transplanting of rice	1

2.6	Field preparation, puddling, transplanting and its advantages, and recommended varieties of rice grown in Nepal	1
2.7	Manures and fertilizer requirements and their management, time and method of their application, fate of added nitrogen in flooded rice cultivation and methods of minimizing nitrogen loss in wet land rice cultivation	1
2.8	Weed and water management practices, sign of maturity, harvesting, threshing, cleaning, yield and storage, national rice research program, its mandate and achievements	1
3	Importance, ecology and agronomy of maize	
3.1	Introduction, economic importance, area and distribution, historical background, classification, history and origin	1
3.2	Soil and climatic requirements, growth stages, seasons grown with their advantages and disadvantages	1
3.3	Field preparation, recommended varieties, seed treatment, seed rate, spacing and methods of sowing	1
3.4	Manure and fertilizer requirements and their scientific management, weed and water management practices, and critical stages of water needs for maize crop	1
3.5	Earthing up operation, foliage removal practices, maturity judgment, harvesting, threshing, cleaning, yield and storage	1
3.6	National maize research program, its mandate and achievements, baby corn production strategies, and introduction to specialty corn	1
4	Importance, ecology and agronomy of wheat	
4.1	Introduction, economic importance, area and distribution, historical background, classification, history and origin	1
4.2	Soil and climatic requirements, growth stages, seasons grown, field preparation, recommended varieties, seed treatment, seed rate, spacing, methods of sowing with their advantages and disadvantages	1
4.3	Manure and fertilizer requirements and their scientific management	1
4.4	Weed and irrigation management practices, critical growth stages for irrigation, maturity, harvesting, threshing, cleaning, yield and storage	1
4.5	National wheat research program, its mandate and achievements, resource conservation technologies in wheat cultivation	1
5	Importance, ecology and agronomy of barley	
5.1	Introduction, economic importance, area and distribution, historical background, soil, climate and season grown	1
5.2	Field preparation, recommended varieties, seed treatment, seed rate, spacing, methods of sowing, manure and fertilizer requirements, weed and water management practices, harvesting, threshing, cleaning, yield and storage	1

6	Importance, ecology and agronomy of finger millet	
6.1	Introduction, economic importance, area and distribution, historical background, soil, climate and season grown	1
6.2	Field preparation for raising nursery, recommended varieties, seed treatment, seed rate, methods of planting, manure and fertilizer requirements, weed and water management practices, harvesting, threshing, cleaning, yield and storage	1
7	Importance, ecology and agronomy of buckwheat	
7.1	Introduction, economic importance, area and distribution, historical background, soil, climate and season grown	1
7.2	Field preparation, recommended varieties, seed treatment, seed rate, methods of sowing, manure and fertilizer requirements, weed and water management practices, harvesting, threshing, cleaning, yield and storage	1
8	Importance, ecology and agronomy of minor-millets and triticale	
8.1	Introduction, economic importance, area and distribution, soil, climate, and season grown	1
8.2	Field preparation, seed treatment, seed rate, methods of sowing, manure and fertilizer requirements, weed and water management practices, recommended varieties, harvesting, threshing, cleaning, yield and storage	1
9	Resource conserving technologies in cereal crops (DSR, SRI, ICM, ZTW)	1
10	Research advances in cereal crops (Bio-fortification, submergence and drought tolerance and other agronomic development)	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Field preparation for raising rice and finger millet nursery	1
2	Raising of rice and finger millet seedlings on rice and finger millet nurseries	1
3	Field preparation for rice transplanting and planting of finger millet	1
4	Field preparation and sowing of wheat and maize by different methods of seeding	1
5	Field preparation and sowing of barley and buckwheat by different methods of seeding	1
6	Seed and seed material treatments with fungicides by different methods	1
7	Manual intercultural operation practices on cereal crops grown during the season	1
8	Top dressing practices with nitrogenous fertilizers on cereal crops grown during the crop season	1
9	Study of yield attributing characters and crop growth analysis of cereal crops grown during the season	1

10	Crop cutting estimation and yield forecasting tools in major cereal crops	1
11	Study on sign of maturity of cereal crops grown during the season	1
12	Weed identification of various cereal crops grown during the season	1
13	Yield estimation and harvesting of cereal crops grown during the season	1
14	Practices on numerical exercises of seed and fertilizer requirements of cereal crops	1
15	Visit and study of various researches conducted at research sites of IAAS, Agronomy Farm on cereal crops	1
	Total	**15**

References

De Dutta, S. K. 1981. Principles and practices of rice production. John Wiley and Sons, New York.

Fageria, N.K., V.C. Baligar and C.A. Jones. 1990. Growth and mineral nutrition of field crops. Marcel Dekker, Inc., New York.

Reddy, S.R. 2009. Agronomy of field crops. Kalyani Publishers, Ludhiana.

Singh, C., P. Singh and R. Singh. 2001. Modern techniques of raising field crops. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi.

Thakur, C. 1979. Scientific crop production (V. 1 & 2). Metropolitan Book Co. Pvt. Ltd., India.

Varma, S.C. and M.P. Singh, 1992. Agronomy of new plant types. Tara Publications, Varanasi.

Course Code : AGR 211

Course Title : Agronomy of Grain-Legumes and Oilseed Crops

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course is designed to deliver perspective of grain legume and oilseed crops to the students and offer them knowledge and skills about improved packages of practices for these crops.

Syllabus

Economic importance and nutritional aspects and role of grain legumes and oilseed crops in farming system, production and productivity trends of grain–legumes and oilseed crops in Nepal over the years, major problems, present status and future research and developmental strategies to uplift the grain-legumes and oilseed production in Nepal, origin, history and distribution, classification, soil and climatic requirements, land preparation and improved cultural practices, seed and sowing, manure and fertilizer application, weed and water management, varieties, harvesting, threshing, yield and storage of lentil, chickpea, pigeonpea, soybean, mungbean, cowpea, blackgram, fababean, rajmabean, horsegram and grasspea, and oilseed crops (rapeseed and mustard, groundnut, sesame, sunflower, niger, linseed, castor and safflower).

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to grain-legumes	
1.1	Importance: economic, nutritional and quality parameters, soil fertility maintenance and biological nitrogen fixation, and increasing cropping intensity	1
1.2	Area, production and productivity of grain–legumes in Nepal over the years	1
1.3	Major problems, present status and future research strategies to uplift the grain-legumes production in Nepal	1
2	Lentil	
2.1	Importance, origin, history and distribution, classification, soil and climatic requirements	1
2.2	Improved cultural practices, seed and sowing, manure and fertilizer application, weed and water management, varieties, harvesting, threshing, yield and storage	1
3	Chickpea	
3.1	Importance, origin, history and distribution, classification, soil and climatic requirements	1
3.2	Improved cultural practices, seed and sowing, manure and fertilizer application, weed and water management, varieties, harvesting, threshing, yield and storage	1
4	Pigeonpea	
4.1	Importance, origin, history and distribution, classification, soil and climatic requirements	1

4.2	Improved cultural practices, seed and sowing, manure and fertilizer application, weed and water management, varieties, harvesting, threshing, yield and storage	1
5	Soybean	
5.1	Importance, origin, history and distribution, classification, soil and climatic requirements	1
5.2	Improved cultural practices, seed and sowing, manure and fertilizer application, weed and water management, varieties, harvesting, threshing, yield and storage	1
6	Importance, origin, history and distribution, classification, soil and climatic requirements, improved cultural practices, manure and fertilizer application, seed and sowing, weed and water management, varieties, harvesting, threshing, yield and storage	
6.1	Green gram	1
6.2	Cowpea	1
6.3	Black gram	1
6.4	Ricebean and rajmabean	1
6.5	Horse gram and grasspea	1
6.6	Sesame	1
6.7	Sunflower	1
6.8	Niger and linseed	1
6.9	Castor and safflower	1
8	Introduction to oilseed crops	
8.1	Importance: economic, nutritional and quality parameters, soil fertility maintenance and increasing cropping intensity	1
8.2	Area, production and productivity of major oilseed crops in Nepal over the years	1
8.3	Major problems, present status and future research strategies to uplift the oilseed production in Nepal	1
9	Rapeseed and Mustard	
9.1	Importance, origin, history, distribution, and classification of rapeseed and mustard	1
9.2	Soil and climatic requirements, land preparation, seed and sowing, and recommended varieties	1
9.3	Manure and fertilizer application and weed and water management	1
9.4	Harvesting, threshing yield and storage	1
10	Groundnut	
10.1	Importance, origin, history, distribution and classification	1
10.2	Soil and climatic requirements, land preparation, seed and sowing, and recommended varieties	1

10.3	Manure and fertilizer application, weed and water management, harvesting, threshing, yield and storage	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Identification of various grain-legumes grown in Nepal	1
2	Identification of various oilseed crops grown in Nepal	1
3	Morphology and phenology of major grain legumes	1
4	Morphology and phenology of major oilseed crops	1
5	Nodules and nodulation behavior in legumes	1
6	Seed treatment of grain-legumes and oilseed crops	1
7	Writing proposal on major grain-legumes and oilseed crops	1
8	Calculation of seed and fertilizer required for the sole and intercropping system with legumes and oilseed crops	1
9	Growing leguminous and oilseed crops at agronomy farm of campus	2
10	Growth analysis (CGR, LAI and DM) of major grain-legumes and oilseed crops	2
11	Yield estimation of grain-legumes and oilseed crops from the different yield attributes	1
12	Field visit to the research/production blocks of legumes and oilseeds at campus premises	1
13	Quality parameters in grain-legumes, oilseeds and adulteration of various oils	1
Total		**15**

References

Fageria, N.K., V.C. Baligar and C.A. Jones. 1990. Growth and mineral nutrition of field crops. Marcel Dekker, Inc., New York.

Rathore, P.S. 1999. Techniques and management of field crop production. Agrobios, India.

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Course-Code : AGR 221

Course Title : Agronomy of Commercial Crops

Credit-Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

The objective of this course is to provide the students with knowledge and skills about the trend and status of major commercial crops of Nepal with their improved practices for the cultivation

Syllabus

Introduction, morphology, importance, origin, history and distribution, varieties, crop adaptation and improved cultivation practices, harvesting and post-harvest handling and recent research advances of major commercial crops of Nepal: sugarcane, cotton and jute.

Outline

Theory

S.N.	Topic	No. of lecture
1	Sugarcane	
1.1	Introduction, morphology, economic importance, origin and history	1
1.2	Sugarcane crop adaptation, cropping system, varieties and land preparation	1
1.3	Planting materials and planting methods adopted for sugarcane planting	1
1.4	Plant nutrient management	1
1.5	Water management, weed management and harvesting	1
1.6	Ratoon management: Pre and post-harvest considerations	1
1.7	Principles of sugar extraction and research advances in sugarcane	1
2	Cotton	
2.1	Introduction, economic importance, origin and history	1
2.2	Morphology and characteristics of cotton plant and cotton fiber	1
2.3	Cotton crop adaptation, cropping system, varieties, seed preparation and sowing	1
2.4	Plant nutrient management and water management	1
2.5	Weed management, defoliation, desiccation and harvesting	1
3	Jute	
3.1	Introduction, morphology, economic importance, origin and history, and jute fiber characteristics	1

3.2	Crop adaptation, varieties, land preparation, seed and sowing	1
3.3	Plant nutrient management, water management, weed management, harvesting and retting	1
	Total	**15**

Practicals

S.N.	Topic	No. of practical
1.	Study of characteristics of different cultivated species of sugarcane	1
2.	Study of growth stages and life cycle of sugarcane	1
3.	Calculation of different seed materials required for various planting methods in sugarcane	1
4.	Estimation of yield and sugar recovery in sugarcane	1
5.	Study of characteristics of different cultivated species of cotton	1
6.	Study of growth stages and life cycle of cotton	1
7.	Study of branching and flowering of cotton	1
8.	Study of characteristics of different cultivated species of jute and their life cycle	1
9.	Proposal writing on major commercial crops	1
10.	Research report writing on major commercial crops	2
11.	Calculations of ANOVA on CRD	1
12.	Calculations of ANOVA on RCBD	1
13.	Growth analysis of major commercial crops (RGR, NAR, LAD and SLA)	1
14.	Estimation of economics of major commercial crops	1
	Total	**15**

References

Bakker, H. 1999. Sugarcane cultivation and management. Springer.

Gosh, T. 1983. Handbook on Jute. FAO.

James, G. 2004. Sugarcane (2nd ed.). Wiley-Blackwell Publishers.

Lisinska, G. and W. Leszczynski. 1989. Potato science and technology. Elsevier Science Pub. Ltd.

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Smith, C.W. and J.T. Cothren. 1999. Cotton: origin, history, technology and production. John Wiley and Sons.

Course Code : **AGR 311**

Course Title : **Principles and Practices of Weed Management**

Credit Hour : **2 (1+1) Full Mark: 50 Theory: 25 Practical: 25**

Objectives

To provide students with basic and applied knowledge about weeds and get them acquainted with the methods of weed management.

Syllabus

Weeds and their importance: harmful and beneficial aspects, characteristics, classification, multiplication/propagation: seed dormancy, viability, germination and dissemination of weeds; crop-weed interference, allelopathy, weed management principles and methods: preventive, physical, cultural, biological, chemical and integrated weed management, history, properties, and differences of herbicides with other pesticides, classifications based on miscellany, chemistry and physiology, structure-activity and selectivity, herbicide injury symptoms, physiology/biochemistry of mode of action, herbicide transformations in plants and soil, herbicide formulations and applications; herbicide mixtures; herbicide resistance and management, herbicide residues in environment, weed management in major crops and cropping systems and non-cropped situations; management of perennial, aquatic, parasitic and invasive weeds, biotechnology in weed management, and herbicide tolerant crops - risks and opportunities.

Outline

Theory

S.N.	Topic	No. of lecture
1	Concept of weed	
1.1	Definition and characteristics of weed	1
1.2	Classification of weed	1
1.3	Economic importance of weed and losses caused by weeds	1
1.4	Ecology of weed	1
1.5	Crop-weed association, interference and competition	1
2	Concept of weed management	
2.1	Methods of weed management: prevention, eradication and control	1
2.2	Physical and mechanical methods of weed control in field crops	1
2.3	Cultural and biological methods of weed control in field crops	1
2.4	Chemical method of weed control in field crops	1
2.5	Integrated weed management practices in major field crops	1

3	Herbicides	
3.1	Definition, evolution, characteristics and prospects of herbicide use	1
3.2	Classification of herbicides: based on chemistry, selectivity, translocation with time , method and mode of action	1
3.3	Herbicide formulations, combination, interaction and rotation	1
3.4	Factors affecting efficacy of herbicides	1
3.5	Environmental and health concern about herbicide: resistance and persistence in soil, effect on environment, precautions and safety measures in applying herbicides	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
1	Collection and identification of common weeds of field crops	2
2	Herbarium preparation of common weeds of field crops	2
3	Identification of herbicides and their formulations	1
4	Identification of equipments and machineries used in weed management	1
5	Calculation of required amount of herbicide with different formulations	1
6	Calibration of sprayers	1
7	Practice on the weed control of field crops by physical and mechanical methods	1
8	Practice on the weed control of field crops by chemical methods	1
9	Safety measures to be followed using chemical method using herbicide	1
9	Sampling and data collection techniques of weeds in crop field	2
10	Case study on weed management practices in farmers' field	2
	Total	**15**

References

Das, T. K. 2008. Weed science – basics and applications. Jain Brothers, New Delhi, 901 pp.

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Gupta, O.P. 2007. Weed management – principles and practices. Agrobios, India.

Jayakumar, R. and R. Jagannathan. 2003. Weed science principles. Kalyani Publishers, India.

Walia, U.S. 2003. Weed management. Kalyani Publishers, India.

Course-Code : AGR 321

Course Title : Seed Science and Technology

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course aims at delivering knowledge and skills to the students about principles and practices of seed technology and improved packages of practices of producing quality seeds of various agronomical crops grown in Nepal.

Syllabus

Seed as a basic unit of crop production, seed, grain, seed materials, classes, seed formation and development processes, seed dormancy, germination, seed production principles and practices, seed development program, seed certification and quality control, seed sampling and routine test, seed processing, storage and marketing, seed treatment, seed policy and legislations in Nepal.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Importance and scope of seed technology	
1.1	Definition of seed, grains, seed materials, seed technology, importance, scope and history of seed production in Nepal	1
1.2	Seed system in Nepal; National seed vision (2013-2025) of Nepal	1
1.3	Classes of seeds (breeder, foundation, certified, improved, truthful labeled; composite and hybrid seeds); chemical composition; quality seed characteristics	1
2.	Seed formation and development	
2.1	Floral induction and flower structures, and asexual and sexual reproduction (sporogenesis, gametogenesis, pollination and fertilization).	1
2.2	Post fertilization changes in flower, embryo, endosperm and seed coat	1
2.3	Factors affecting seed growth and development	1
3.	Seed germination and seed dormancy	
3.1	Seed germination: types, process and factors affecting seed germination	1
3.2	Seed dormancy: causes, types and methods of breaking seed dormancy	1
4.	General principles and agronomic management in seed production	
4.1	Genetic and agronomic principles of quality seed production	1
4.2	General seed production of rice and wheat	1

4.3	General seed production of maize	1
4.4	General seed production of grain legumes (lentil, cowpea and soybean)	1
4.5	Basic principles and practices of hybrid seed production (rice/maize)	1
5.	Seed development program in Nepal	
5.1	Government and non-government agencies and their roles for quality seed production (central, regional and district level agencies)	1
5.2	Inbreed and hybrid varieties development process/program in Nepal	1
5.3	Variety release and registration process, released varieties, variety development and maintenance breeding, seed multiplication process, and barriers of seed sector development in Nepal	1
6.	Field inspection, seed certification and seed quality control system	
6.1	Field inspection: objectives, general principles and method of field inspection, and concept of seed quality control	1
6.2	Seed certification: objectives, concepts, general principles, agencies involved in seed certification in Nepal, and minimum seed certification standards	1
6.3	Organizational structure of seed certification agencies in Nepal and process of seed certification, international organizations and seed certification	1
7.	Seed testing	
7.1	Seed sampling, general principles of sampling, types of seed samples and procedure of seed sampling, precautions, and procedure of sample registration.	1
7.2	Seed germination test and purity analysis: principles and methods of germination and purity test; seed rate calculation	1
7.3	Definition of seed vigour, seed viability and seed moisture test: principles and methods of vigour, viability and moisture test.	1
8.	Seed processing, storage and marketing	
8.1	Seed crop harvesting, drying, threshing and cleaning	1
8.2	Seed storage: objectives and principles, storage devices with merits & demerits	1
8.3	Seed marketing: seed distribution system, seed balance sheet, seed buffer stock, seed import & export, and problems of seed marketing in Nepal.	1
9.	Seed treatment	
9.1	Seed priming, seed inoculation, seed dormancy breaking: objective, concept, process and precautions	1
9.2	Seed disinfection and disinfestation: objective, concept, process and precautions	1
10.	Seed policies and legislation	
10.1	Seed policies in Nepal, seed law enforcement, procedure of seed law enforcement (duties, power, offenses and penalties of seed inspector)	1
10.2	Seed legislation: types of seed legislation and seed legislation system in Nepal (seeds act)	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Identification of seeds of various field crops grown in Nepal	1
2.	Identification of planting materials of various crops grown in Nepal	1
3.	Measurements of agronomical characteristics of crop seeds	1
4.	Practices on seed priming before sowing	1
5.	Practices on seed purity analysis using seed purity seed board	1
6.	Practices on seed germination testing in lab and field	1
7.	Practices on seed viability testing using TZ test	1
8.	Practices on seed vigor testing using brick and gravel	1
9.	Practices on seed moisture testing using machine and hot oven	1
10.	Preparation of seed materials for planting	1
11.	Treatment of various seed materials	1
12.	Field visit to the nearby seed grower's group of the campus	1
13	Introduction to seed sampling procedures	1
14	Seed blending practices commonly practiced in Nepal and world	1
15.	Estimation of seed amounts for various agronomic crops	1
Total		**15**

References

Agrawal, R. L. 2005. Seed technology. Oxford and IPH Publishing Co. Pvt. Ltd. New Delhi.

Copeland, L. O. and M. B. McDonald. 1985. Principles of seed Sscience and technology. Burgress Publishing Company, Minnesota, USA.

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Course-Code : AGR 411

Course Title : Farming System and Advances in Agriculture

Credit-Hour : 2 (2+0) Full Mark: 50 Theory: 50 Practical: 00

Objectives

To make students acquainted with the concept agricultural systems through ecosystem anf farming systems approach along with the principles, tools and techniques of modern agriculture.

Outline

Theory

S.N.	Topic	No of lecture
1	System and System approach in agriculture	3
1.1	System concept, definition, types, elements and characteristics	
1.2	Ecosystem: Structure, Function and Types; Farming system	
1.3	Classification of farming systems (FAO)	
2	Determinants of Farming Systems: Biotic and Abiotic factors	3
2.1	Climatic Factors	
2.2	Edaphic (land and soil) Factors	
2.3	Biotic and Socioeconomic (economic, social and policy) Factors	
3	Nepalese Farming Systems	3
3.1	Source of Livelihood and Economic security	
3.2	Components and Their Interrelationship	
3.3	Classification of Nepalese Farming Systems	
4	Resource Base of Nepalese Farming Systems and their	3
4.1	Integration	
4.2	Land Resources: Status, Prospects and Management	
4.3	Animal resources: Status, Prospects Management	
	Plant resources : Status, Prospects and Management	
5	Nepalese Farming Systems in Perspective	3
5.1	Nepalese Farming Systems: Past, present and Future	
5.2	Nepalese Farming Systems at the Cross Roads	
5.3	Farming system research: evolution, methodology and scope	
6	Advances in Agriculture	3
6.1	A Retrospect and Need for modernization	
6.2	Resource Base and Modern Agriculture	
6.3	Modern agriculture : Environment and Food Security	
7	Emerging Challenges in Agriculture: Biophysical and	3
7.1	Socioeconomic	
7.2	Climate Change: Effect, Concept of Adaptation and Mitigation	
7.3	Drought and Nutrient Stress Conditions and Coping with them	
	Changing Socioeconomic Conditions and Strategies to handle	
8	Tools of Modern agriculture: A discourse	3
8.1	Precision Farming: Current status and opportunities for	
8.2	adoption	
8.3	GIS, GPS and remote sensing for crop management	
	GIS, GPS and remote sensing for crop management	

9	Other Tools	3
9.1	Yield Estimation and Yield Forecasting in Agriculture	
9.2	Simulation and Modeling: Computer Based Applications	
9.3	Nano, Nuclear and other advanced Technologies in Agriculture	
10	Protected Agriculture, and Family Farming and Contract	2
10.1	Farming	
10.2	Protected Agriculture: concept, characteristics and scope	
	Contract and Family Farming: concept, characteristics and scope	
11	Opportunities and Limitations of Using Modern Tools in Nepal	1
	Total	**30**

References

Ernst, van H.and K., van Der Post. 2004. Protected cultivation: construction, requirements and use of greenhouse in various climates. Agromisa Foundation, Wageningen, Netherlands.

Govardhan, V. 2000. Remote sensing and water management in command areas: agroecological prospectives. IBDC.

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Rana, S.S. (ed.). 2011. Farming systems and sustainable agriculture department of agronomy. CSKHPKV, Palampur.

Sharma, P. 2007. Contract farming. Daya Publishing House, New Delhi.

Course-Code : AGR 421

Course Title : Organic Farming and Sustainable Agriculture

Credit-Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

To make students acquainted with the concept of theory and practices of organic farming and its role in sustainability of Nepalese agriculture.

Outline

Theory

S.N.	Topic	No of lecture
1	Sustainable Agriculture	3
1.1	Sustainability and Sustainable Development: A Retrospect	
1.2	Sustainable Agriculture: Evolution and Characteristics	
1.3	Sustainable Agriculture in United Nation's Sustainable Development Goal (SDGs)	
2	Towards Sustainable agriculture	3
2.1	Need for Sustainable Agriculture: a retrospect & implication in Nepal	
2.2	LEISA, Ecological Agriculture and its principles	
2.3	Various Approaches towards Sustainable Agriculture	
3	Organic Farming	3
3.1	Concept, Evolution and Definitions	
3.2	Principles of Organic Agriculture	
3.3	Status of Organic Agriculture in the World and in Nepal	
4	Components of Organic Farming, Interrelationship and Management	3
4.1	SOM and Local Ecological processes: feeding and enabling the Soil	
4.2	Biodiversity & Local Resources: Managing the Pests & Risk Aversion	
4.3	Science, Innovation and Tradition: Building Synergy among the Components	
5	Organic Production Systems Against Adversities	3
5.1	Climate Change and Organic Farming	
5.2	Organic Agriculture for Marginal Environment	
5.3	Certification and Marketing: Strengthening Local Food System	
	Total	**15**

Practical

S.N.	Topic	No of lectures
1.	Understanding and discussion on the terminologies related to sustainable agriculture and organic farming	1
2.	Study of the indicators of sustainable agriculture and examine them against local farming Condition: A case study	2
3.	Assessing the level of biodiversity in the locality and understand their role in sustaining agriculture	1
4.	Practice on the preparation of manures and composts with innovative way and apply them to the crop	2
5.	Practice on the preparation of vermicompost and bokasi and use	2
6.	Practice on the preparation of Jhol mal, Panchgabya, Jeevamrit, etc. and use	2

7.	Preparation of local bio-pesticides and their use in common pests	2
8.	Enumeration of underutilized crops in the locality and their value in food system	2
9.	Remark form the student on the lesson learnt from organic agriculture	1
	Total	**15**

References

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3.5 Animal Breeding

Course Code : ANB 321

Course Title : Principles and Practices of Animal Breeding

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, the students will be able to understand basic principles and fundamentals of animal breeding, and application of animal breeding technique.

Syllabus

Animal breeding, importance and its scope in livestock improvement. Genetic resources of Nepal. Variations and causes of variation importance of heritability and repeatability. Concept of genetic resistance to diseases and parasites. Selection differential, methods and basis of selection; Mating system inbreeding and out breeding. Nuclear transplantation, transgenic animal production and its significance in genetic improvement of livestock Hormonal mechanism in reproduction, male and female reproductive system, estrus detection, estrus cycle and induction of synchronization of ovulation. Introduction advantages and limitation of A.I. method of semen collection, dilution, preservation, thawing, transportation and technique of A.I. importance of embryo transfer, super ovulation, synchronization, collection and transfer of embryo.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction, history and importance of animal breeding	1
2	Animal genetic resources (AnGR) of Nepal	2
3	AnGR conservation and utilization: principles, methods and needs	1
4	Variation and its causes: heredity, environment and GXE interaction; importance of heredity and environment	2
5	Traits of economic importance in livestock and poultry	1
6	Phenotypic expression of genes (gene action): additive and non-additive (dominance, over-dominance, incomplete dominance, co-dominance, epistasis and transgressive variation)	2
7	Concept of heritability: definition, broad and narrow sense heritability, importance of narrow sense heritability in animal genetics, and uses of heritability estimates.	1

8	Concept of repeatability: definition, explanation and uses of repeatability (life time average and MPPA)	1
9	Selection: principles, basis and methods of selection	1
10	Selection for qualitative and quantitative traits	1
11	Livestock breeding/mating systems: random mating, assortative mating; and inbreeding (line breeding and close breeding)	1
12	Out breeding (pure breeding, crossbreeding, upgrading and hybridization), and close and open nucleus breeding systems	1
13	Current livestock improvement programs in Nepal	1
14	Current animal breeding researches in Nepal, their concepts, objectives and methods	1
15	Animal reproduction: male and female reproductive systems	2
16	Animal reproduction: estrus detection, induction of estrus synchronization, pregnancy diagnosis and parturition	2
17	Animal endocrinology: hormones, their functions and mechanism	2
18	Artificial insemination: principles and methods	1
19	Semen collection, processing (dilution, preservation and transport); and physical and chemical properties of quality semen	2
20	Animal biotechnology: recent advances in animal biotechnology	1
21	Introduction to bioinformatics and their uses in animal breeding	1
22	Multiple ovulation and embryo transfer (MOET) technology: collection and transfer of embryo, and importance of MOET.	2
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Estimation of heritability	2
2.	Estimation of repeatability	1
3	Estimation of variance components, means, breeding value, PBA and MPPA	2
4.	Calculation of inbreeding relationship and coefficient	1
5.	Estimation of selection parameters, selection index etc	2
6.	Preparation of artificial vagina (A.V.) and collection of semen	2
7.	Evaluation of semen	2
8.	Heat detection indifferent farm animals	1
9.	Palpation of female reproductive organ	1
10.	Insemination technique	1
Total		**15**

References

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3.6 Animal Nutrition and Fodder Production

Course Code : ANU 121

Course Title : Fodder Production and Pasture Management

Credit Hour : 2 (1+ 1)Full Mark: 50 Theory: 25 Practical: 25

Objectives

Upon completion of this course, the students will be able to understand the basic principles of fodder and forage production, preservation and pasture management.

Syllabus

Technology of fodder and pastures. Importance and scope of fodder production and pasture management in Nepal. Factors affecting chemical composition and nutritive value of fodder. Cultivation practices of common annual and perennial fodder and grasses. Alternative feeding resources in use and practices. Silvi-pasture system and its importance. Pasture: common pasture species and cultivars. Pasture establishment, measurement and nutrition of grazing animals. Preservation and conservation of forage and fodder (hay and silage).

Outline

Theory

S.N.	Topic	No. of lecture
1	Importance and scope of fodder production in Nepal	1
2	Edaphic factors affecting fodder crops (climate and soil)	1
3	Factor affecting nutritive value of fodder	1
4	Classification of forage and anti-nutritional factors present in forage	1
5	Nutritional deficiency disease of pasture animal	1
6	Cultivation practices of important legumes and non-legumes including grasses. Perennial grasses: oat, jawar, bajra, teosinte, maize, siratro, berseem, lucerne, vetch, guar, stylo, molasses, setaria, para, rhodes, napier, desmodium & comfrey	2
7	Alternative feeding resources in use and practice	1
8	Determination of pasture yield	1
9	Hay and silage making and their importance	1
10	Silvi-pastoral system and its importance	1
11	Introduction, definition, importance and scope of pasture	1

12	Common pasture species and cultivars	1
13	Pasture, establishment; seed quality, sowing, soil environment, cultivated seed beds and management of pasture	1
14	Nutrition of grazing animals, nutritive value of pasture, herbage impact and composition	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
1	Identification of fodder crops, grasses, legumes and tree fodders	1
2	Sampling of forage grasses and tree fodders for chemical analysis	2
3	Cultivation practices of annual and perennial grasses	2
4	Cultivation practices of annual and perennial legumes	2
5	Treatments of straw; urea, urea molasses, NaOH treatment	1
6	Hay and Silage making	2
7	Preparation of herbarium sheet	2
8	Preparation of fodder tree saplings, plantation and management	1
9	Pasture measurement procedure and yield estimation	1
10	Preparation of seasonal fodder cultivation calendar	1
	Table	**15**

References

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Pandey, K.K. 1982. Fodder tree and tree fodder in Nepal. Swiss Federal Institute of Forestry research. Birmensdorf, Switzerland.

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Stevens, J.E. 1991. Fodder and pasture seed program. Consultant report. HMG, Nepal DOAD, Livestock Development Project. Nepal.

Course Code : ANU 311

Course Title : Animal Nutrition and Feeding Practices

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

This course will enable students to understand basic principles of animal nutrition and fundamental aspects of feed processing for different farm animals.

Syllabus

Terminology of animal nutrition. Comparative composition of plant and animal cells and tissues, proximate analysis. Classification, function and deficiency symptom of nutrients. Digestion, absorption and metabolism of nutrients in different animals. Feed ingredients and their classification. Feeding standards and nutrient requirements for different farm animals.

Outline

Theory

S.N.	Topic	No. of lecture
1	Terminology of animal nutrition	1
2	Comparative composition of plant and animal cells and tissues	1
3	Classification, function, requirement and food sources of protein, carbohydrate and lipid	2
4	Classification, function, requirement and food sources of macro- and micro-minerals, vitamins and water	2
5	Digestion of food in ruminants and non-ruminants	2
6	Absorption of food nutrients in animals	1
7	Metabolism of nutrients	1
8	Feed ingredients and their classification	1
9	Feeding standard for cattle, buffalo, sheep, goat, pig and poultry	1
10	Evaluation of nutrient value of feed; digestibility coefficient and factors affecting digestibility coefficient	1
11	Evaluation of protein value of feed	1
12	Evaluation energy value of feed; TDN, SE and Partition of energy.	1
	Total	**15**

Practical

S N.	Topic	No. of practical
1	Identification of feed ingredients	1
2	Sampling of feed ingredients for chemical analysis and toxicity	1
3	Preparation of standard solution for proximate analysis	1
4	Proximate analysis of feeds and fodder–DM	1
5	Proximate analysis of feeds and fodder–CP	1
6	Proximate analysis of feeds and fodder–EE	1
7	Proximate analysis of feeds and fodder–CF	1
8	Proximate analysis of feeds and fodder–ASH	1
9	Computation of ration for cattle	1
10	Computation of ration for buffalo	1
11	Computation of ration for sheep and goat	1
12	Computation of ration for pig	1
13	Computation of ration for poultry	1
14	Preparation of urea molasses mineral block	1
15	Preparation of urea molasses liquid supplement	1
	Total	**15**

References

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Benerjee, G.C. 2019. Principles of animal nutrition and feeds (revised ed.). Oxford and IBH pub. Co. Pvt. Ltd.

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Ranjhan, S.K.1993. Animal nutrition and feeding practices in India. Vikash Pub. House Pvt. Ltd India.

Ranjhan, S.K 1993. Animal nutrition in the tropics. Vikash Pub. House Pvt. Ltd India.

3.7 Aquaculture and Fisheries

Course Code : AQF 221

Course Title : Introductory Ichthyology

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

Upon completion of the course, students will be able to explain types of fishes and their importance, understand their morphology, anatomy and physiology.

Syllabus

Introduction, definitions, economic importance, taxonomy of economically important fishes of Nepal, morphology, anatomy and physiology of different organ systems of fish.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction	
1.1	Definition of fish and Ichthyology and other related terms	1
1.2	Economic importance of fish	1
2.	Taxonomy	
2.1	General characters and classification of pisces (Elasmobranchi, Holocephali, Dipnoi and Teleostomi)	1
2.2	Classification of fishes of Nepal (upto Order)	1
3.	Morphology	
3.1	External features of a typical fish (including general shape and size), structure and functions of skin	1
3.2	Structure and functions of scales, fins and lateral line system	1
4.	Anatomy and Physiology:	
4.1	Study of location and functions of internal organs	1
4.2	Structure and functions of different organ systems	
a	Digestive system: Structure & functions of alimentary canal, physiology of digestion	2
b	Respiratory system: Structure and function of gills; mechanism of Respiration; Accessory respiratory organs of fish	2
c	Circulatory system: structure and functions of heart	1

d	Nervous and endocrine systems: structure and functions of brain, hypothalamus, spinal cord & pituitary gland; endocrine functions of testis, ovary & pancreas	2
e	Reproductive system: structure and functions of gonads	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
	Study of external features of fish	1
	Study of morphometric measurements and meristic counts of fish	1
	Study and identification of fishes of Nepal (at least one from each Order)	2
	Study of different types of scales of fish	1
	Study and count of lateral line scales of fish	1
	Study of different types of fins of fish	1
	Study of Internal organs of fish	1
	Study of alimentary canal and relative gut length (RGL) of fish	1
	Study of gills of fish	1
	Study of accessory respiratory organs of fish	1
	Study of location and function of heart of fish	1
	Study of location and function of brain of fish	1
	Study of male and female reproductive organs of fish	1
	Study of gonado-somatic index (GSI)	1
	Total	**15**

References

Brown, E.E. and J.B. Gratzek. 1980. Fish farming handbook. AVI publishing company Inc, Westport, Connecticut.

Evans, D.H. and J.B. Claiborne. 2006. The physiology of fishes. CRC Press.

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Shrestha, J. 1981. Fishes of nepal. CDC, TU, Kathmandu, Nepal.

Srivastava, C.B.L. 1999. Fish biology. Narendra Publishing House, Delhi, India.

Course Code : AQF 311

Course Title : Principles of Aquaculture

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

Upon completion of the course, students will be able to understand the basics of aquaculture, differentiate various cultivated fish species of Nepal and know various management aspects, breeding and diseases of fish.

Syllabus

Definition, desirable characters, pond construction and water quality and its management, fish farming systems, fish breeding, fish diseases and their control and post harvest technology.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction	2
1.1	Definition of fisheries and aquaculture and other related terms; and desirable characters of fish for culture	
1.2	Biology of cultivated fishes (carps, catfish, trout and tilapia)	
2.	Pond construction and management	
2.1	Site selection and pond construction	1
2.2	Water quality: temperature, turbidity, dissolved oxygen, pH, total hardness, total alkalinity and plankton	2
2.3	Pond management: liming and fertilization, feeding; aquatic weeds, weed & predatory fishes and predators and their control	2
3.	Fish farming system: classification on the basis of intensity, enclosure, water mass, fish species and integration and their cultivation	2
4.	Fish Breeding	
	Sexual dimorphism, management of brood fish	1
	Breeding of common carp, Chinese carps and Indian major carps	2
5.	Common fish diseases & parasites: causal organisms, symptoms & control measures of Saprolegniasis, EUS, Tail/fin rot, White spot, Dactylogyrosis, Gyrodactylosis, Argulosis, Asphyxiation & Gas bubble disease	2
6.	Introduction to post-harvest technology	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
	Visit of fish farm facilities of local campus/in the locality	1
	Identification of cultivated fishes of Nepal	1
	Methods of water sampling	1
	Determination of water quality parameters: temperature, transparency, DO & pH	1
	Study of collection and identification of planktons	1
	Study of methods of pond fertilization and liming	1
	Study of methods of feeding and feed preparation	1
	Identification of fish breeding equipments	1
	Identification of brood fish; study of breeding of cultured fish species	1
	Study and identification of fish inducing agents (natural and synthetic): collection and preservation of fish pituitary gland	1
	Study of identification and use of fishing gears	1
	Study of behavioral signs of diseased fish	1
	Study of examination of skin and gills	1
	Identification of common drugs and chemicals used in fish health management	1
	Study of various methods of fish preservation	1
	Total	**15**

References

ICAR. 2006. Handbook of fisheries and aquaculture. ICAR, New Delhi.

Jha, D.K. 1991. Laboratory manual of Fish disease. Tribhuvan University, IAAS, Rampur.

Jhingran, V.G. and R.S.V. Pullin. 1985. A hatchery manual for the common, chinease and indian major carps. Asian Development Bank, ICLARM, Manila, Philippines.

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Course Code : AQF 321

Course Title : Inland Fisheries and Limnology

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

Upon completion of the course, students will be able to explain types of Inland, natural and man-made water bodies and sustainable fisheries, habitat and aquatic biodiversity conservation and their limnological aspects.

Syllabus

Introduction, definition, river system, riverine fisheries, lake and reservoir fisheries, aquatic biodiversity and conservation; conservation strategies, limnological aspects of water bodies.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to inland fisheries, rivers, lakes and reservoirs	1
2	Definition of fisheries, Limnology, habitat conservation, aquatic biodiversity and other related terms	1
3	Inland capture fishery resources of Nepal and their potentials (man-made and natural lakes, reservoirs, *ghols*, swamps, flood plains and wetlands)	2
4	Major river systems of Nepal and riverine fisheries	1
5	Major lakes and reservoirs of Nepal and Lacustrine and reservoir fisheries	1
6	Aquatic biodiversity: warm and cold water fish species and their distribution in different water bodies	1
7	Aquatic biodiversity conservation: ranching, habitat (destruction & restoration), fishing season and closed season, fish ladder, trapping & hauling)	2
8	Fishing gears and methods: types of gears, legal and illegal fishing	1
9	Aquatic life protection act of Nepal (2017 B.S.) and amendments	1
10	Limnological aspects:	
10.1	Physical parameters of natural water bodies	1
10.2	Chemical parameters of natural water bodies	1
10.3	Biological parameters of natural water bodies	1

	Concept and principles of sustainable fisheries management (socio-economic and environmental issues)	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
	Study of physical parameters of water bodies	1
	Study of chemical parameters of water bodies	1
	Study of biological parameters of water bodies	1
	Study and visit of lakes of Nepal	1
	Study and visit of reservoirs of Nepal	1
	Study and visit of rivers of Nepal	1
	Study of gears and their uses	1
	Study of fish sampling techniques	1
	Study of fish preservation and identification (upto Genus level)	2
	Study of fish catch composition analysis	2
	Study and collection of Shellfish	1
	Study and visit of dams and fish passage/ladder	1
	Study and visit of fish market	1
	Total	**15**

References

Biswas, S.P. 1993. Manual of methods in fish biology. South Asian Pub., New Delhi, India.

Gupta, S.K. and P.C. Gupta. 2006. General and applied ichthyology (Fish and fisheries). S. Chand & Company Ltd., New Delhi.

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3.8 Entomology

Course Code : **ENT 121**

Course Title : **Introductory Entomology**

Credit Hour : **3 (2+1) Full Mark: 75 Theory: 50 Practical: 25**

Objectives

Upon the completion of this course, the students will be able to understand the fundamentals of introductory entomology, and learn about valuable insects, such as honeybee, silkworm and lac insects.

Syllabus

Introduction: beneficial and harmful 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 and introduction to industrial entomology.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction: definition and position of insects in animal kingdom	1
2.	Reasons for the dominance of insects over other animals	1
3.	Beneficial and harmful effects of insects	1
4.	External morphology:	
	a. Body regions, external processes and cuticle	1
	b. Head: segmentation, structure, orientation, mouth parts and their modifications	1
	c. Photoreceptors (compound eyes, ocelli and stemmata)	1
	d. Thorax: segmentation, structure, legs and their modifications	1
	e. Wing venation and their modifications	1
	f. Abdomen: segmentation, structure and appendages	1
5.	Internal Anatomy:	
	a. Digestive system and excretory system	1
	b. Reproductive system (male and female)	1
	c. Respiratory system	1
	d. Circulatory system	1
	e. Nervous system	1
6.	Insect metamorphosis and seasonal adaptation	1

7.	Insect seasonal cycles	1
8.	Classification and study of economically important orders and families of insects	
	a. Thysanura, Odonata and Blattodea	1
	b. Orthoptera	1
	c. Thysanoptera, Isoptera, Phthiaptera and Siphonaptera	1
	d. Hemiptera	1
	e. Homoptera	1
	f. Coleoptera	1
	g. Lepidoptera	1
	h. Diptera	1
	i. Hymenoptera	1
9.	Introduction to industrial entomology	
	a. Apiculture	1
	-General introduction and colony management	
	-Bee foraging and pollination	1
	b. Sericulture	1
	-Silkworm rearing and management	
	-Mulberry garden management	1
	c. Lac culture	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
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.	Internal anatomy of an insect (digestive, reproductive (male and female), nervous, circulatory and respiratory systems)	1
9.	Insect metamorphosis	1
10.	Types of larvae and pupae	1
11.	Modern beehive and its parts	
12.	Life-cycle of honeybee	1
13.	Introduction and principles of insect rearing	1
14.	Methodology, care and handling of beneficial insect rearing	1

15.	Classification of insects (Important families of the order): Thysanura, Odonata, Blattodea, Orthoptera, Thysanoptera, Isoptera, Phthiaptera, Siphonaptera, Hemiptera, Homoptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera.	1
	Total:	**15**

References

Borer, D. J., D. M. Delong and C. A. Tripplehorn. 1976. An introduction to the study of insects. Holt. Rinehart and winston, Inc., New York.

Richards, O. W. and R. G. Davies. 1977. Imm's general textbook of entomology. Vol. I and II. Chapman and Hall, London.

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Chapman, R.F. 2008. The insects: structures and function (4th ed.). Cambridge University Press.

Course Code : ENT 211

Course Title : Principles and Practices of Insect-Pest Management

Credit Hour : 3 (2+ 1)Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course will enable students to understand the fundamentals of insect pest management, and handle pest management practices independently.

Syllabus

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.

Outline

Theory

S.N.	Topic	No of lecture
1.	Agricultural crop pests and pest management:	
1.1	concept, significance, historical aspects and terminologies	1
1.2	factors responsible for increasing insect-pests in agriculture	1
2.	Understanding economics of insect-pest management:	
2.1	concept of threshold level and its significance 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	physical: principle, methods and significance	1
3.2	mechanical: principle, methods and significance	1
3.3	cultural and ecological:	
	-principle and significance in pest management	1
	-common and improved farm practices	1
3.4	legislative & quarantine: concept of legislative measures & role of quarantine in pest management	1
3.5	host plant resistance	
	- basic concept, history and significance in pest management	1
3.6	- mechanisms and measurement of host plant resistance	1
	insect behavior manipulation:	
	- basic concept and significance in insect pest management	1
	- types of attractants and repellents	1
3.7	- concept and methods of genetic control	1
	biological:	
	- concept and significance of biological pest management	1
	- parasitoids and predators	1
	- insect pathogens	1
3.8	- bio-control techniques in pest management	1
	insecticides:	
	- history of insecticides and their significance in pest management	1
	- types, classification and hazardous level of pesticides	1
	- formulation of insecticides	1
	- pesticide poisoning, first aid and antidotes	1
4.	Integrated pest management methods (IPM):	
	-concept of IPM and its significance in pest management	1
	-components and available tools of IPM in Nepal	1
	-concept of IPM extension model: farmers field school	1
	-growers response to IPM and the future of IPM in Nepal	1
5.	Insecticides misuse and precautionary measures in Nepal	1
6.	Pesticide residue assessment practices and significance	1
7.	Insect-pest management in precision agriculture	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Field visit and interaction with farmers on insect-pest problems	1
2	Agro-vet visit and interaction with input supplier on pesticides management measures	1
3	Identification and proper handling of pesticides in laboratory condition	1
4	Pesticide dilution and dose calculation for field application	1
5	Study on the use and handling of pesticide appliances	1
6	Scouting techniques to common insect-pests at nearby farm	1
7	Identification and uses of microbial pesticides	1
8	Preparation of food bait for field practice	1
9	Preparation of poison bait and use for rodent control	1
10	Collection, preparation and use of botanical materials for insect-pest management	1
11	Monitoring of insect-pests by different traps (pheromone/pitfall/sticky traps)	1
12	Monitoring of insect-pests in light trap	1
13	Practices on IPM-FFS (AESA analysis, predator- pest model, zoo/case study, field layout)	3
	Total	**15**

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Course Code : ENT 221

Course Title : Economic Entomology

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

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

Syllabus

Systematic position, distribution, host identification, nature and extent of damage, life cycle, seasonal histories and control measures of important insect and non-insect pests (rodents birds, mites, wild animals and others) of cereals and millets, pulses, oilseeds, vegetables, fruits, industrial crops, spices and condiments grown in Nepal. Important storage grain pests and their control. Introduction and management of medical and veterinary, vector borne, polyphagous, soil hibernating and resistant insect-pests.

Outline

Theory

S.N.	Topic	No of lecture
	Distribution, host, incidence, life cycle, seasonal histories and management of major insect-pests of:	
1	Cereals:	
1.1	Rice	2
1.2	Maize	1
1.3	Wheat and millet	1
	Pulses:	
2.1	Chickpea, pea, black and green grams	1
2.2.	Gram, lentil and pigeon pea	1
	Oilseeds:	
3.1	Mustard, rapeseed, sesame and sunflower	1
3.2	Ground nut and soybean	1
	Vegetables:	
4.1	Cole-crops (cauliflower, cabbage and broccoli).	1
4.2	Cucurbits (cucumber, pumpkin, bitter gourd, bottle gourd, sponge gourd, pointed gourd, summer squash, chayote and melons)	1
4.3	Solanaceous crops (potato, tomato, chilly and eggplant)	1
4.4	Onion, okra and garlic	1

	Fruits:	
5.1	Mango	1
5.2	Citrus	1
5.3	Banana	1
5.4	Litchi	1
5.5	Apple and other temperate fruits	1
5.6	Pomegranate and kiwi	1
	Industrial crops:	
6.1	Sugarcane	1
6.2	Jute	1
6.3	Cotton	1
	Plantation crops, spices and condiments:	
7.1	Tea and coffee	1
7.2	Ginger and cardamom	1
	Ornamental crops: rose, gladiolus, marigold, carnation and chrysanthemum	1
	Storage products:	
9.1	Cereals and pulses	1
9.2	Oilseeds, flour, tubers and other	1
	Major vector insects and rodents:	
10.1	Insect vectors of plant and animal diseases	1
10.2	Rodent and vertebrate pests	1
11	Medical, veterinary and household insect-pests:	
11.1	Mosquitoes, louse, fleas, flies and cockroach	1
11.2	Ticks, mites and parasites	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Periodic visits to campus vicinity for crop pests monitoring	1
2	Collection and identification of predators, parasites and pollinators	1
3	Collection and identification of insect-pests of paddy/wheat and their	1
4	damage symptoms	1
5	Collection and identification of insect-pests of maize/millets and their	1
6	damage symptoms	1
7	Identification of insect-pests of sugarcane and their damage	1
8	symptoms	
	Collection and identification of insect-pests of cotton and their	1
9	damage symptoms	
	Collection and identification of insect-pests of jute and their damage	1
10	symptoms	
	Collection and identification of insect-pests of legume and oilseed	1
11	crops and their damage symptoms	
	Collection and identification of insect-pests of cole-crops & cucurbits	1
12	and their damage symptoms	
	Collection and identification of insect-pests of solanaceous crops,	1
13	onion, okra and their damage symptoms	
	Collection and Identification of insect pests of mango, litchi &	1
14	banana and their damage symptoms	1
	Collection and identification of insect-pests of citrus & temperate	
15	fruits and their damage symptoms	1
	Collection and identification of insect-pests of storage products and their damage symptoms	
	Rearing of common insect-pests	
	Total	**15**

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Course Code : ENT 321

Course Title : Pesticide Pollution and Environment Protection

Credit Hour : 1 (1+0) Full Mark: 25 Theory: 25 Practical: 00

Objectives

Upon the completion of this course, the students will be able to understand chemical pollution, in cases and learn about novel means to minimize pollution, especially due to pesticides in agriculture including human health with least disturbance to the environment.

Syllabus

Introduction, significance and overview of environmental (chemical/pesticide) pollution, basic understandings of pollutants, pesticide pollution in Nepal, chemical use and persistence of organic pesticides, effect of pesticides on non-target organisms including farmers and consumers health, pesticide hazard assessment (survey/ surveillance/field monitoring and sampling for pesticide residues), integrated approach of pest management, phyto-sanitary measures- ISPMs and RSPMs, bio-diversity and use of novel approaches in agriculture and human health system, and plant quarantine pesticide acts and regulations.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Definition, terminology and significance, and overview of environment pollution	1
2.	Basic understanding of pesticide pollution: pollutants and pollution, and sources of pollution	1
3.	Causes of pesticide pollution: over and misuse of chemical pesticides in agriculture, industries, urbanization wastes; and pathways of pesticide movement	1
4.	Status of pesticide consumption in Nepal and farmers practices	1
5.	Types of hazardous pesticides used in Nepalese agriculture system	1
6.	Consequences of overuse and misuse of chemical pesticides: pesticide poisoning, pesticide resistance, pest resurgence and pesticide residue	1
7.	Effect of pesticides on non-targeted organisms: bio-agents, humans, plants, animals and ecosystem	1

8.	Pesticide hazard assessment: pest and pesticide survey, and field monitoring	1
9.	Techniques of pesticide hazard assessment: (types, RBPR -1)	1
10.	Integrated pest management (IPM) and scope of chemical pesticides in IPM system	1
11.	Use of novel techniques in pest management system	1
12.	Plant quarantine/phyto-sanitary measures: ISPMs, RSPMs and NSPMs	1
13.	National policies on pest management and environment protection: plant protection acts and regulation and pesticide acts and regulation	1
14.	Environment protection related acts and regulations	1
15.	International policies on pesticide management and environment protection: international treaties and conventions and international organization	1
	Total	**15**

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3.9 Horticulture

Course Code : **HRT 111**

Course Title : **Introductory Horticulture**

Credit Hour : **3 (2+1) Full Mark: 75 Theory: 50 Practical: 25**

Objectives

This course provides students knowledge and skill about principles and practices of basic horticulture.

Syllabus

Definition, branches, classification and importance of horticultural crops; relation to other disciplines including value addition; ecological regions and niches in Nepal for different horticultural crops; feasibility of horticulture development in Nepal; climatic factors affecting crop production, measures to overcome environmental stress; basic principles of orchard establishment. Principles and practices of plant propagation, training and pruning of fruit trees and vines; orchard management practices, growth and development of horticultural crops; juvenility, flowering, pollination, fruit set and fruit growth, ripening and fruit drop, tuber and bulb formation; plant growth substances in horticulture; high density and multistoried planting, organic farming, off-season production and protected horticulture; peri-urban horticulture; horticultural genetic resources and indigenous horticultural plants.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Definition, branches and classification of horticultural crops	1
2.	Relation to other disciplines, and value addition of horticultural crops	1
3.	Importance of horticultural crops in Nepal	1
4.	Ecological regions and niches for different horticultural crops in Nepal	1
5.	Feasibility of horticulture development in Nepal	1
6.	Climatic factors affecting horticultural crop production: light, temperature and heat budget; rain, humidity, hailstone and wind	2
7.	Measures to overcome environmental stress	1
8.	Basic principles of orchard establishment: site selection, layout and planting; and types of horticultural enterprises	2
9.	Principles and practices of plant propagation	

	a. Sexual propagation and specialized structures	1
	b. Cutting and layering	1
	c. Grafting and budding	1
	d. Mist- and micro propagation	1
10.	Principles and practices of training and pruning: objectives, system of training, types of pruning and pruning of different fruit crops	2
11.	Orchard management practices: soil fertility management; irrigation and drainage; soil water conservation measures, and weed management	2
12.	Seed and bud dormancy	1
13.	Germination and juvenility	1
14.	Flowering and fruiting (fruit set, fruit growth, fruit drop, ripening, abscission and senescence)	1
15.	Tuber and bulb formation	1
16.	Plant growth substances	1
17.	Functions of plant growth substances	1
18.	Commercial uses of plant growth substances in horticultural crops	1
19.	Principles of off-season and protected horticulture	1
20.	Organic farming, needs and prospects	1
21.	Principles of high density and multi-storied cropping	1
22	Principles of peri-urban horticulture and soilless culture	1
23	Genetic resources and indigenous horticultural plants	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Identification of horticultural tools and equipments	1
2.	Identification of fruits, vegetables and ornamental plants	1
3.	Identification of major horticultural crop growing areas and regions of Nepal	1
4.	Layout of orchard for different systems of planting fruit crops	1
5.	Preparation of contour line for planting trees across the sloping land	1
6.	Preparation of pit and planting of fruit saplings	1
7.	Training of fruit trees	1
8.	Pruning of fruit trees	1
9.	Propagation of horticultural crops by grafting	1
10.	Propagation of horticultural crops by budding	1
11.	Propagation of horticultural crops by layering	1
12.	Propagation of horticultural crops by cutting	1
13.	Preparation of different concentrations of PGR for horticultural uses	1
14.	Seasonal work experiences practices in horticultural crops	2
	Total:	**15**

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Course Code : **HRT 121**

Course Title : **Ornamental Horticulture**

Credit Hour : **3 (2+1) Full Mark: 75 Theory: 50 Practical: 25**

Objectives

This course provides basic knowledge and skill on principles and practices of landscape designs and cultivation practices of major ornamental plants in Nepal.

Syllabus

Importance of ornamental gardening in human life; classification of ornamental plants based on their aesthetic and functional uses; styles of gardening and their components; principles and elements of landscape gardening; factors affecting landscape design; landscape and planning; indoor gardening, pot culture, hanging garden and bonsai; flower arrangement; exhibition and flower judging; establishment and maintenance of lawn; establishment of nursery enterprises. Cultivation practices including protected cultivation and postharvest handling of major flowers.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Importance and scope of ornamental horticulture	1
2.	Classification of ornamental plants in various ways	2
3.	Styles of gardening and their components	2
4.	Principles of landscape gardening	1
	Elements of landscape gardening	1
5.	Factors affecting landscape design	1
6.	Landscape planning process	1
7.	Indoor gardening, types of indoor plants, and care and maintenance of indoor plants	1
8.	Pot culture and hanging basket	1
9.	Bonsai techniques	1
10.	Flower arrangement,	1
11.	Flower exhibition and judging	1
12.	Establishment and maintenance of lawn	1
13.	Establishment of nursery enterprises	1
14.	Nursery media, containers, equipments and structures	2
15.	Cultivation practices including protected cultivation and postharvest handling of:	
	a. Gladiolus	1
	b. Rose	1
	c. Carnation	1
	d. Orchid	1
	e. Dahlia	1
	f. Tuberose	1
	g. Gerbera	1
	h. Chrysanthemum	1
	i. Marigold and Bachelor's button	1
	j. Cactus and succulents	1
	k. Bougainvillea	1
16.	Postharvest of ornamental plants including chain of life concepts	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Identification of ornamental plants with reference to habit, season of flowering, color of flowers and uses	1
2.	Preparation of seeding/planting bed of seasonal flowers	1
3.	Preparation of lawn	1
4.	Preparation of *Bonsai*	1
5.	Flower arrangement	1
6.	Maintenance of indoor plants	1
7.	Designing gardens for residential purpose	1
8.	Designing gardens for public purpose	1
9.	Training and pruning of ornamental plants	1
10.	Propagation of ornamental plants by sexual methods	1
11.	Propagation of ornamental plants by asexual methods	1
12.	Preparation of media for potting ornamental plants	1
13.	Potting, repotting and manuring of indoor plants	1
14.	Herbarium collection of ornamental plants	1
15.	Visit of nursery and landscape of local area	1
	Total:	**15**

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Course Code : HRT 211

Course Title : Vegetable and Spice Crop Production

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course provides basic knowledge and skill on principles and practices of vegetable and spice production with emphasis on cultivation, off-season production, and marketing.

Syllabus

Importance, scope and status of vegetable and spice production in Nepal; cultural practices with respect to origin, distribution, area, production and trade, botany including major breeding aspects, variety, climate and soil, field management, off season production; seed production, plant protection, harvesting, post-harvest handling and marketing of potato and solanaceous vegetables, onion, cole-crops, cucurbits, root crops, bean, peas, leafy vegetables, and okra; spices: ginger, turmeric, garlic, cumin, coriander and fenugreek and introduction to indigenous, under-exploited and minor crops.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Importance and scope of vegetable and spice crop production in Nepal	1
2.	Status and problems of vegetable and spice crop production in Nepal	1
3.	Cultural practices including origin and distribution, area, production and trade, botany including major breeding aspects, climate and soil, variety, field management, off season production, plant protection, seed production, harvesting, post harvest handling and marketing of following crops:	
3.1	Potato	2
3.2	Tomato	2
3.3	Egg plant	1
3.4	Chilli and sweet pepper	1
3.5	Broad leaf mustard (Rayo)	1
3.6	Cress, spinach and swiss chard	1
3.7	Cauliflower	1
3.8	Cabbage	1
3.9	Brocooli and Knolkhol	1
3.10	Radish	1

3.11	Carrot and turnip	1
3.12	Peas	1
3.13	Beans (French bean and asparagus bean)	1
3.14	Cucurbits (cucumber, water melon, bitter gourd, sponge gourd, pumpkin and summer squash) with riverbed farming	3
3.15	Onion	1
3.16	Garlic	1
3.17	Ginger	1
3.18	Turmeric	1
3.19	Okra	1
3.20	Coriander, Fenugreek and Cumin	1
4.	General introduction of minor and under exploited vegetables:	
	4.1 Chayote, pointed gourd, musk melon, ridge gourd and ivy gourd	1
	4.2 Sweet potato, yam, garden beet, Colocasia, cassava, elephant foot yam and ground apple	1
	4.3 Lettuce, dill, asparagus, brussels' sprouts, celery and amaranthus	1
	4.4 Drumstick, tree tomato, parsnip and bamboo shoot	1
	Total:	**30**

Practical

S.N.	Topic	No. of practical
1.	Identification of vegetable and spice crops	1
2.	Identification of seeds of vegetables and spices	1
3.	Nursery raising of vegetables	1
4.	Practice on transplanting and watering	1
5.	Identification of major cultivars of major vegetable crops	1
6.	Practice on various intercultural operations and mulching	1
7.	Staking and pruning in vegetable crops	1
8.	Practices on manure and fertilizer application	1
9.	Pesticide application in vegetable crops	1
10.	Use of PGRs in vegetable production	1
11.	Harvesting and processing for marketing	1
12.	Display and judging of fresh vegetables	1
13.	Study morphological characters of edible parts of major crops	1
14.	Forcing cucurbits in winter	1
15.	Layout of kitchen garden	1
	Total	**15**

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Course Code : HRT 221

Course Title : Fruit and Plantation Crop Production

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course provides basic knowledge and skill on principles and practices of fruit and plantation crop production with special emphasis on management practices and marketing.

Syllabus

Importance, scope and history of fruit development in Nepal, cultivation practices of temperate, tropical, sub-tropical and emerging fruit crops with reference to their origin, botany, uses, distribution, area and production, climate, soil, varieties, planting, propagation, training and pruning, flowering, fruit set, fruit drop, manure and fertilizers, irrigation, inter-cropping, use of bio-regulators, diseases and insect-pests, major physiological problems, harvesting, storage and marketing of apple, pear, peach, plum, walnut, apricot; mandarin, sweet orange, lime, lemon, grape, strawberry, guava, mango, banana, papaya, pineapple, litchi, jackfruit, kiwi, olive, pomegranate, persimmon; and plantation crops: tea, coffee and cardamom. Introduction to indigenous and underexploited fruit crops.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Importance, scope, problems and status of fruit crops in Nepal	1
2.	History and government policy of fruit development in Nepal	1
3.	Constraints of fruit production in Nepal	1
4.	Cultivation practices of temperate fruits:	
	a. Apple	2
	a. Pear	1
	b. Peach and plum	1
	c. Apricot and walnut	1
	d. Grape	1
5.	Cultivation practices of tropical and sub-tropical fruits:	
	a. Mandarin	2
	b. Sweet orange	1
	c. Lime and lemon	1
	d. Mango	2
	e. Banana	1
	f. Papaya	1
	g. Pineapple	1
	h. Litchi	1
	i. Guava	1
	j. Jackfruit	1
6.	Cultivation practices of emerging fruits:	
	a. Kiwi and Olive	1
	b. Pomegranate and Persimmon	1
	c. Strawberry	1
7.	Introduction to indigenous and underexploited fruits	1
8.	Cultivation practices of plantation crops	
	a. Tea	2
	b. Coffee	2
	c. Cardamom	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Identification of major temperate, subtropical and tropical fruit trees	1
2.	Pomological classification of fruit trees	1
3.	Training and pruning of major fruit trees	1

4.	Vegetative propagation of fruit trees	
	a. Propagation by grafting	1
	b. Propagation by layering	1
	c. Propagation by budding	1
5.	Identification of banana suckers and management of sword sucker	1
6.	Flowering and fruiting behavior of major fruit crops	1
7.	Preparation and application of PGRs for flowering, fruit set and fruit ripening	2
8.	Fertilization and manuring of fruit trees	1
9.	Study of different systems of irrigating fruit trees	1
10.	Preparation and uses of pesticides in fruit trees	1
11.	Preparation and use of Bordeaux mixture and paste in fruit trees	1
12.	Processing of coffee/tea/cardamom	1
	Total:	**15**

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Westwood, M.N. 1993. Temperate-zone pomology: physiology and culture. Portland, Or: Timber Press.

Course Code : HRT 311

Course Title : Protected and Precision Horticulture

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

The objective of this course is to sensitize the student with modern technology for production of horticultural commodities (fruits, vegetables and flower crops) round the year. This course provides knowledge and skills on principles and practices of either partially or fully protected cultivation of horticultural crops.

Syllabus

Definition, principles, scope and importance of protected horticulture. Historical perspectives of protected cultivation in the world and in Nepal. Types of protected structures with their merits/demerits. Environmental control and soil, water and nutrient management for protected horticulture. Soil based and soilless (hydroponics, aeroponics and aquaponics) cultivation practices in the world and in Nepal under protected structures. Use of protected structures for seedling/sapling production. Integrated pest and disease management in protected cultivation. Cultivation of commercial horticultural crops under protected structures: Tomato, Capsicum, Cucumber, melons, Squash, Leafy vegetables, Gerbera, Rose, Strawberry, Mango and papaya. Precision farming, technological advancement and use in protected horticulture.

Outline

Theory

S.N.	Topic (specific to protected cultivation)	No. of lecture
1.	Definition, principles, importance and scope of protected cultivation of horticultural crops	1
2.	Different growing structures for protected horticulture (glasshouse, naturally ventilated greenhouse, hi-tech and semi hi-tech structures, polyhouses, heating tunnel, screen house, rain shelters).	2
3.	Historical perspective and status of protected horticulture in Nepal and around the world	1
4.	Selection of site and designing of appropriate protected structures based on microclimate	1
5.	Principles of protected farming and common practices of farming (soil based and soilless - hydroponics, substrate based, aeroponics and aquaponics)	2

6.	Effect of different environmental and soil factors on crop growth in protected culture: temperature, humidity, soil moisture, air circulation, pH, electrical conductivity, solar radiation and light intensity.	2
7.	Roofing structures, roofing materials and ventilation systems	1
8.	Micro irrigation technology, fertigation practices and soil management	1
9.	Automation of irrigation and nutrient management	1
10.	Crop management: training, pruning, staking and use of PGRs	1
11.	Major insect-pests and diseases in protected cultivation and their integrated management	1
12.	Practical use of sensors for information gathering and geostatistics in hi-tech horticulture	1
13.	Nursery media and seedling/sapling raising in protected structures	1
14.	Protected cultivation techniques of	
	Tomato and Sweet pepper	2
	Roses, Carnation and Gerbera	1
	Cucumber, Squash and Melons	2
	Strawberry	1
	Mango and Papaya	2
15.	Sapling production from tissue-cultured plantlets of Banana, Citrus and Pineapple	
16.	Precision horticulture: definition, principles and concepts	1
17.	Geographic information system (GIS), global positioning system (GPS) and their applications in precision horticulture	1
18.	Remote sensing and its application in precision horticulture	1
19.	Site specific management practices for precision horticulture	1
20	Prospects and constraints of precision horticulture in the context of Nepal	1
21.	Precision farming techniques for vegetable and fruit crops	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Prepare a drawing of different protected structures based on ecological zones	1
2.	Prepare a drawing of poly-tunnels/net houses with appropriate materials, resources availability and estimate the cost based on current market value	1
3.	Prepare a drawing of glasshouse with appropriate materials, resources availability and estimate the cost based on current market value	1

4.	Different types of media and materials for raising seedlings/saplings	1
5.	Training, pruning and staking techniques of tomato/sweet pepper	1
6.	Study of media, solarization and fumigation for protected structures	1
7.	Study of heating and cooling systems in greenhouse	1
8.	Preparation of heating tunnel or plastic house structures	1
9.	Bed preparation and planting of tissue-cultured plantlets	1
10.	Practical use of GPS in precision farming	1
11.	Pest monitoring and management practices in protected structures	1
12.	Prepare a report on protected structure based on field visit of commercial greenhouse/polyhouses: cropping calendar with cultivation techniques	1
13.	Prepare a project of a horticultural crop for protected cultivation technology	3
	Total:	**15**

References

Hartmann., H.T., Kester, D.E., Davies, F.T. and Geneve, R.L. 2009. Plant propagation: principles and practices (7th Ed.). PHI Learning Private Limited, New Delhi. 880 p.

Nelson, P.V. 1991. Green house operation and management. Ball publishing USA.

Reddy S., B. Janakiram, T. Balaji, S. Kulkani and R.L. Mishra. 2007. High-tech floriculture. Indian Society of Ornamental Horticulture, New Delhi, India.

Reed, D. 1996. Water, media and nutrition for green house crops. Ball publishing USA.

Shrestha, G. K. 2016. Fruit and plantation crops: basic principles, production techniques and practical exercises. Heritage Publ. and Dist., Nepal.

Course Code : HRT 321

Course Title : Agroforestry

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

This course provides basic knowledge on principles and practices of agroforestry systems.

Syllabus

Concept of agroforestry: definition, terminologies, components, importance and scope; role of trees in agroforestry system; characteristics of agroforestry species; classification of agroforestry systems; interaction between trees and crop/livestock components; diagnosis and design methodology, Farming System Research and Extension (FSRE) approach to agroforestry and soil and water conservation strategies for agroforestry.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Definition, terminologies and components of agroforestry system	1
2.	Importance and scope of agroforestry in Nepal	1
3.	Characteristics of trees for agroforestry development	1
4.	Classification of agroforestry system	2
5.	Shifting cultivation: practices, problems and potential	1
6.	Diagnosis and design approach to agroforestry project	2
7.	Farming System Research and Extension (FSRE) approach to agroforestry	1
8.	Quantitative assessment of woody species	1
9.	Soil and water conservation strategies through agroforestry approach	2
10.	Sloping agriculture land technology	1
11.	Tree - crop/livestock interaction	2
	Total:	**15**

Practical

S.N.	Topic	No. of Practical
1.	Preparation of 'A' frame	1
2.	Estimation of tree height	1
3	Determination of land slope	1
4	Study of characteristics of tree for agroforestry system	1
5.	Determination of contour line by 'A' frame	1
6.	Study of different agroforestry models	1
7.	Nursery establishment and plantation of agroforestry species	1
8.	Identification of agroforestry species	1
9.	Study of different SALT models	1
10.	A case study of agroforestry system (survey)	2
11.	A visit to agroforestry project	1
12.	Preparation of agroforestry project	2
13.	Quantitative assessment of woody species	1
	Total:	**15**

References

Dwivedi, A.P.1992. Agroforestry: principles and practices. Oxford and IBH Publ. Co. Pvt. Ltd.

Singh, S.P. 1998. Handbook of agroforestry. Agrotech Publishing Academy, India.

Thapa, F. 2001. Nepalese flora for agroforestry systems. S.B. Bhandari, Kathmandu, Nepal.

Course Code : HRT 411

Course Title : Post Harvest Horticulture

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course provides basic knowledge and skill on principles and practices of handling, processing, storing and marketing of fresh and perishable horticultural commodities.

Syllabus

Importance and status of post harvest horticulture in Nepal; major constraints in the development of post harvest enterprises; causes of postharvest deterioration; post harvest physiology of fruits, vegetables and cut flowers; post harvest disease and pest; quality of horticultural produce; pre-harvest factors affecting quality; temperature management, storage and transportation; post harvest profile of commodities: vegetables, fruits, cut and loose flowers; processing and preservation of fruits and vegetables; marketing, quality assurance and legislation.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Importance and status of post harvest horticulture in Nepal	1
2.	Constraints in the development of post harvest enterprises	1
3.	Causes of post harvest deterioration (physical, physiological and pathological)	1
4.	Basic differences in the physiology of attached and detached organs	1
5.	Post harvest physiology	
	a. Transpiration	1
	b. Respiration	1
	c. Ethylene production	1
	d. Ripening of fruits and vegetables	2
6.	Factors affecting physiological activities of harvested organs	1

7.	Maturity indices of major fruits, vegetables and flowers	1
8	Postharvest operation:	
	a. Cleaning, grading and sizing	1
	b. Curing, waxing and degreening	1
	c. Pre-cooling, packaging and transportation	1
9.	Post harvest profiles (storage temperature, relative humidity, gases composition, packaging materials, cold chain management etc.) of different commodities	2
	a. Vegetables	
	- Leaf and stem vegetables	
	- Cole crops	
	- Cucurbits	
	- Leguminous crops	
	- Solanaceous crops	
	- Roots and bulb crops	
	b. Fruits	2
	- Tropical and subtropical (banana, citrus, mango, pineapple, papaya and litchi)	
	- Temperate (apple, pear and plum)	
	c. Flower	1
	- Loose flower (marigold and gomphrena)	
	- Cut flower (rose, gladiolus, orchid and carnation)	
10.	Post harvest diseases and their control	1
11	Post harvest insect-pests and their control	1
12	Physiological disorders, their causes and preventive measures	1
13	Marketing of harvested commodities	1
14	Status and problems of marketing of horticultural produce in Nepal	1
15.	Principles and methods of storage	2
16	Processing and preservation of fruits and vegetables	
	a. Jam, jelly, marmalade and juice making	1
	b. Tomato ketchup and pickle making and drying	1
17.	Quality of produce and its evaluation	1
18.	Current legislation and its implication on production and marketing of fresh horticultural produce in country and export market	1
	Total:	**30**

Practical

S.N.	Topic	No. of Practical
1.	Identification of tools and equipments used in post-harvest horticulture	1
2.	Study of temperature and relative humidity in zero energy cooling chamber	1
3.	Determination of total soluble solids and titrable acidity	1
4.	Maturity judgment and harvesting of fruits and vegetables	1
5.	Artificial ripening of fruits	1
6.	Use of different chemicals for post harvest longevity	1
7.	Market survey to find out postharvest problems	1
8.	Development of proposal for post-harvest enterprises	1
9.	Preparation of jam	1
10.	Preparation of jelly or marmalade	1
11.	Preparation of tomato ketchup	1
12.	Preparation of pickles	1
13.	Drying or dehydration of fruits and vegetables	1
14.	Preparation of juice	1
15.	Waxing of fruits	1
	Total	**15**

References

Bautista, O.K. 1990. Postharvest technology for southeast asian perishable Crops. University of the Philippines Technology and Livelihood Resource Center, Philippines.

Gautam, D.M. and D.R. Bhattarai. 2006. Postharvest horticulture. Public printing press, Kat., Nepal.

Shrestha, G. K. and B. Khanal. 2014. Bagbani Duitiye (Hort. Second): phalphul, pushpa tatha parirakchen (in Nepali). Heritage Publishers and Distributors, Kathmandu, Nepal.

Wills, R. B. H, W. B. McGlasson, D. Graham, T. H. Lee and E. G. Hall 1996. Postharvest: an introduction to physiology and handling of fruits and vegetables. CBS Publishers and Distributors, New Delhi, India.

3.10 Livestock Production and Management

Course Code : LPM 111

Course Title : Introductory Animal Science

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

The main objective of this course is to teach the students about importance of livestock and poultry industry; prevention and control measures of commonly occurring diseases and parasites of livestock and poultry.

Syllabus

Importance, scope hindrances of livestock and poultry in Nepal.Zoological classification of farm animals and birds, Differences between ruminant and non-ruminant.Commonly used terms of animal husbandry.Ageing, weighing, identifications,Animal restraining and handling.Marketing and transportation. Sign of health and diseases. Care and management of sick animals. Control and prevention of major diseases and parasites. Importance of barn sanitation and waste handling.Farm records.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction and importance of livestock and poultry	**1**
2.	Scope and constraints of livestock and poultry production in Nepal	**1**
3.	Terminologies related to livestock and poultry production	**1**
4.	Zoological classification of farm animals and poultry	**2**
5.	Breed characteristics of important breeds of cattle (Jersey, Holstein Friesian, Brown Swiss, Achhami, Lulu, Yak/Nak, Chauri, Red Sindhi, Sahiwal and Hariana), buffalo (Murrah, Nili Ravi, Jafrabadi, Tarai, Lime and Parkote), sheep (Bhyanglung, Baruwal, Kage, Lampuchhre, Merino, Rambouillet and Polworth.) and goat (Jamunapari, Barbari, Black Bengal, Beetal, Boer, Saanen, Khari, Tarai, Sinhal and Chyangra)	**2**
6.	Breed characteristics of important breeds of Pig (Chwache, Bampudke, Hurrah, Hampshire, Landrace, Duroc and Yorkshire) and poultry (Cobb 500, New Hampshire, Leghorn, Australorp, Giriraj and Lohmann)	**1**

7.	Differences between ruminants and non-ruminants	**1**
8.	Animal restraining and handling	**1**
9.	Identification of farm animals	**1**
10.	Weighing and ageing of farm animals	**1**
11.	Marketing and transportation of farm animals including poultry	**2**
12.	Sign of health and diseases in farm animals	**2**
13.	Care and management of sick animals	**1**
14.	Care and management of newborn calf, kid and lamb	**1**
15	Care and management of newborn piglet	**1**
16.	Feeds, fodder and their classification	**2**
17.	Feeding of farm animals	**1**
18.	Importance of barn sanitation and waste handling	**2**
19.	Important farm records, their preparation and maintenance	**2**
20.	Prevention and control of major diseases of livestock and poultry (H.S., B.Q., FMD, Brucellosis, Ranikhet, Fowl pox, Coccidiosis, Gumboro, Marek's, Swine fever and Porcine Reproductive and Respiratory Syndrome (PRRS)	**2**
21.	Prevention and control of major parasites of livestock and poultry (Ticks, Lice, Fleas, Liver fluke, Ascariasis and Tape worm)	**2**
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Identification of external body parts of cattle, buffalo, sheep, goat, pig, poultry	2
2.	Study of livestock housing system	1
3.	Study of body temperature, respiration rate and pulse rate	1
4.	Cleaning and disinfection of the animal barn	1
5.	Ageing of farm animals(Cattle , Buffalo, Sheep, Goat and Swine)	1
6.	Estimation of body weight by body measurement	2
7.	Identification of different farm animal and poultry breeds	2
8.	Numbering of farm animals and birds	2
9.	Study of different types of farm records	1
10.	Handling and casting of farm animals	1
11	Identification of feed ingredients and fodders	1
Total		**15**

References

Banerjee, G.C. 2013. A text book of animal husbandry (8th ed.). Oxford and IBH Pub., India.

Damron, W.S. 2012. Introduction to animal science: global, biological, social and indutry prospective (4th ed.). PHI Learning Pvt. Ltd., India.

Dhital, B . and M. Adhikari. 2016. Principle and practices of livestock production and management. Buddha publications pvt. Ltd, Kathmandu, Nepal.

Thalkar, M.G. 2018. Livestock production and management. Jaya Pub. House, New Delhi, India.

Thomas, G.F. and R.E. Traylor. 2014. Scientific farm animal production; An introduction to animal science, 10th ed., PHI Learning Pvt. Ltd., India.

Course Code : LPM 211

Course Title : Ruminant Production

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

Upon successful completion of this course, students will be able to rear cattle, buffalo, sheep and goat and identify different breeds of cattle, buffalo, sheep and goat (indigenous and exotic breeds).

Syllabus

Different breeds of cattle (Hariana, Sindhi, Brown Swiss, Jersey, HF, Achhami, Lulu, Siri, Yak and Chauri), Buffalo (Murrah, Jaffarabadi, Nili-Rabi, Surti, Lime, Parkote and Gaddi), Sheep (Merino, Rambouillet, Rommey, Polworth, Bhyanglung, Kage, Baruwal and Lampuchhre), Goat (Terai, Khari, Sinhal, Chyangra, Jammunapari, Boer, Beetal, Barbari and Sannen). Care and management of cattle, buffalo, goat and sheep. Housing principles and types of housing for ruminants. Artificial rearing of newborns, feeds and feeding of ruminants. Castration, dehorning, grooming, dipping, dusting, shearing, judging and selection. Use of draft animals. Milk secretion and let down of milk and milking methods.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction, scope and statistics of ruminants.	1
2.	Care and management of cattle and buffalo.	1
3.	Care and management of yak/Nak and chauri.	1
4.	Care and management of sheep and goats.	1
5.	Housing principles and housing of ruminants.	1

6.	Artificial rearing of newborn calf (cattle, buffalo, yak and chauri).	2
7.	Artificial rearing of newborn kids and lambs.	1
8.	Castration, dehorning of farm animals.	1
9.	Grooming and dusting of farm animals	1
10.	Dipping and shearing of farm animals.	1
11.	Judging and selection of cattle, buffalo.	1
12	Use of draft animals.	1
13	Milking methods and clean milk production	1
14	Milk secretion and let down of milk	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
1.	Study of animal housing of different kinds	1
2.	Castration of ruminants	1
3.	Dehorning of male animals (goat and sheep)	1
4.	Dehorning of cattle	1
5.	Grooming of cattle	1
6.	Cleaning and sanitation of animal barns	1
7.	Cleaning and sanitation of milking parlor	1
8.	Milking practices in cow	1
9.	Milking practices in Buffalo	1
10.	Ration formulation for ruminants	1
11.	Artificial feeding of newborns	1
12.	Dipping of sheep	1
13.	Dusting of small ruminants	1
14.	Shearing of wool	1
15.	Pregnancy diagnosis in cattle, buffalo, sheep and goat	1
	Total	**15**

References

Banerjee, C.K. and N.N. Pathak. 2004. Textbook on buffalo production. Vikas Pub. House Pvt. Ltd. New Delhi, India.

Banerjee, G.C. 1991. A text book of animal husbandry (7th ed.). Oxford & IBH Pub., India.

Dhital, B . and M. Adhikari. 2016. Principle and practices of livestock production and management. Buddha publications pvt. Ltd, Kathmandu, Nepal.

Ghose, N. 2019. Livestock production and management. PHI Learning Pvt. Ltd, India

Course Code : LPM 221

Course Title : Pig and Poultry Production

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

This course will enable the student to gain knowledge on scientific rearing of pigs and poultry.

Syllabus

Pig production: prominent breeds. Care, management and feeding of different age groups. Housing (systems, materials and essentials). Commonly used management practices. Economics of pig farming. Poultry production: prominent indigenous, exotic and commercial breeds of broilers, layers, ducks and turkeys. Rearing and feeding of broilers and layers of different age groups. Housing system (requirements, materials and design). Egg formation, Selection of eggs for incubation. Factors essentials for successful hatching. Brooding methods, common managerial practices. Vaccination, debeaking, candling, sexing, straight run chicks, selection and grading of eggs. Selection and culling of layers, commercial farm biosecurity, poultry production economics.

Outline

Theory

S. N.	Topic	No. of lecture
1.	Introduction, scope and statistics of pig and poultry production in Nepal	**1**
2.	Care and management of newborn piglets (brooder management)	**1**
3.	Care and management of pregnant sow and breeding boar	**1**
4.	Housing systems, materials and essentials for housing of pigs	**1**
5.	Commonly used management practices of poultry (light management)	**1**
6.	Materials and design of poultry housing	**1**
7.	Egg formation and selection of eggs	**1**
8.	Incubation of eggs	**1**
9.	Factors essential for successful hatching	**1**
10.	Brooding methods (natural and artificial)	**1**
11.	Common managerial practices for broilers and layers	**1**
12.	Biosecurity on pig and poultry farm	**1**
13.	Selection and culling of pig and poultry	**1**
14.	Duck raising	**1**
15.	Turkey raising.	**1**
	Total	**15**

Practical

S.N.	Topic	No. of practical
1.	Identification of different breeds of swine	1
2.	Housing and feeding of swine	1
3.	Identification (tagging and ear notching) of new born piglets	1
4.	Castration, pig-iron administration and vaccination of swine	1
5.	Identification of broiler and layer breeds	1
6.	Disease identification of poultry	1
7.	Vaccination of poultry	1
8.	Debeaking of poultry	1
9.	Candling, grading and selection of eggs	1
10.	Selection and culling of layers	1
11.	Ration formulation of pig	1
12.	Ration formulation of poultry	1
13.	Economics of pig raising	1
14.	Economics of poultry raising(broilers and layers)	1
15.	Feeding and watering of poultry	1
	Total	**15**

References

Banerjee, G.C. 2013. A text book of animal husbandry (8th ed.). Oxford and IBH Publ., India.

Banerjee, G.C. 1998. Feeds and principles of animal nutrition. Oxford and IBH Publ., India.

Banerjee, G.C. 1995. Poultry (3rd ed.). Oxford and IBH Pub., New Delhi, India.

Course Code : LPM 411

Course Title : Dairy Science and Technology

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

Upon completion of the course students will be able to determine the milk constituents and get acquaintance with milk and its properties, dairy microbiology, methods of milking, mammary gland and milk and milk products processing, milk payment system and identify different parts of dairy plant and their management.

Syllabus

Dairying in Nepal, its scope and comparison with developed countries, definition of milk and diagrammatic representation of milk constituents, composition of milk, factors affecting the composition, nutritive values and physical and chemical properties of milk. Mammary gland features and biosynthesis of milk, methods of milking, clean milk production and importance and factors affecting the clean milk production. Flavor defects in milk. Types of microorganism their sources of contamination; uses and significance of microorganism in dairy industry; probiotic bacteria and their importance in human health. Purchasing, collection and processing of milk; preparation of different milk products; maintenance of dairy plant and development of project for mini-dairy plant.

Outline

Theory

S.N.	Topic	No. of lecture
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 (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 M.O. 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 terminology	1
15.	Milk purchasing, collection system, preservation and safe transportation to the chilling center	1
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 bactofugation 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 heating methods	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.	Development of a project for mini-dairy plant.	1
26.	Cleaning, sanitation and maintenance of dairy plant in brief	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Study of commonly used dairy equipments 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 and their parts, and method of cream separation.	1
10.	Introduction (nutritive values, uses and flow diagram of method of preparation) and preparation of concentrated dairy products (Ice cream and Khoa)	1
11.	Introduction (nutritive values, uses and flow diagram of method of preparation) and preparation of coagulated dairy products(Cheese, Chhana and Paneer)	1
12.	Introduction (nutritive values, uses and flow diagram of method of preparation) and preparation of fermented dairy products (Yoghurt and Probiotic)	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**

References

Clarence, H.E., W.B. Combs and H. Macy. 1994. Milk and milk products. TATA, McGraw-Hill Publishing Company Ltd, India.

Prasad, J. 1997. Animal husbandry and dairy science. Kalyani Publishers, Inida.

Sukumar, De. 2000. Outlines of dairy technology. By Oxford University Press. New Delhi, India.

Chandan, R.C. and K. Arun, 2013. Manufacturing yoghurt and fermented milk (2nd ed.). Willey-Blackwell Publication, USA.

Course Code: LPM 412

Course Title: Animal Ethics and Welfare

Credit Hours: 2 (1+1) **Full Marks: 50** **Theory: 25** **Practical: 25**

Objectives

During and at the end of the course, the student shall be able to define animal welfare within the context and understand the various spectrum of animal health and welfare.

Syllabus

Discussion on concepts and importance of animal welfare, spectrum of animal welfare, five freedoms of animal welfare, ethical concerns of welfare, normal behaviors of animals, identified behavioral indicators of welfare, interaction of humans with animals, animal-human abuse link, role of the veterinarian in animal welfare, responsible pet ownership, welfare issues in population control programs, cultural differences with respect to philosophy and practices on animal ownership and use, animal welfare for wildlife and animal under disasters management, discussion on concepts in animal welfare including practice governing animal control as well as protection and prevention of domestic and wild animals.

Course Breakdown

Theory

S.N.	Topic	No.of Lectures
1	Introduction to concepts of animal welfare and ethics	1
2	Concept of one health and one welfare	1
3	Welfare assessment methods and the five domains	1
4	Human-animal interactions and human vs animal welfare	1
5	Physiological and behavioral indicators of animal welfare	1
6	Immune and production indicators of welfare	1
7	Welfare of animals used in research, testing and education	1
8	Farm animal welfare, animals during transportation and issues	1
9	Animal welfare in commercial livestock farming practices	1
10	Pet and companion animal welfare, and population control programmes	1
11	Wild animal welfare	1
12	Animal welfare during natural calamities and disaster management	1
13	Insurance policy for livestock and poultry	1
14	Animal welfare legislations and organizations	1
15	Provision relating to Animal Quareantine	1
	Total	15

Practicals

S.N.	Topic	No. of practical
1	Techniques of soundness examination for animals	1
2	Farm animal based measure of welfare –Large animal	1
3	Farm animal based measure welfare assessment- Small animal	1
4	Animals used in entertainment	1
5	Animal Health and Livestock Service Act 1999 (2055) & Rules 2000 (2056)	1
6	Animal Slaughterhouse and Meat Inspection Act, 1999 (2055), and Regulation 2001 (2057)	1
7	Provisions relating to Animal Quarantine, and Insurance policies	1
8	Animal welfare and ethical issue in poultry transport	1
9	Animal welfare and ethical issue in animal breeds import	1
10	Environmental stressors (heat, cold, air quality and space) requirement for different animals	2
11	Slaughter house visit report (nearby campus)- case study	2
12	Current status of animal ethical issues and animal welfare issues in livestock farms- case study	2
	Total	**15**

References

Appleby, C. M., Olsson, A.S., and Galindo, F. 2018. Animal welfare (3rd Ed). CABI.

Broom, D.M. and Fraser, A.F. 2015. Domestic animal behaviour and welfare (5th Ed). CABI.

WSPA. 2013. Concepts in animal welfare (3rd ed.). University of Bristol and WSPA

Fraser A.F. and D.M. Broom. 1997. Farm animal behaviour and welfare (3rd Ed.). CABI Pub.

Gregory, N.G. and Grandin, T. (eds.). 2007. Animal welfare and meat production (2nd Ed). CABI.

Stafford, K. 2006. The welfare of dogs – Animal welfare series V. 4. Dordrecht: Springer.

3.11 Plant Breeding

Course Code : PLB 111

Course Title : Principles of Genetics

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course is designed to help students to understand the science of inheritance through classical and molecular aspects of function of genes and principles of genetics.

Syllabus

Classical and molecular perspectives of genes, genetics and function of genes, cell division, life cycle of some organisms, linkage of genes, Mendelian inheritance pattern, probability for Mendelian genetics, gene interactions, transmission of quantitatively inherited genes, inheritance of cytoplasm genes, control and transmission of sex in plants and animals, structure and function of genes, modification of forms of genes, nature of jumping genes and gene regulation.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction, scope, history of genetics	1
2	Cell cycle, cell division (mitosis)	1
3	Cell division (meiosis)	1
4	Life cycles (Virus, maize)	1
5	Life cycles (bacteria, man)	1
6	Mendel's law of segregation and Simple problems	1
7	Mendel's law of, independent assortment, complex problems	1
8	Probability and its calculations in reference to independent assortment	1
9	Statistical hypothesis testing to conclude phenotypic	1
10	Gene interaction, A variety of dominance	1
11	Enzymatic explanation for phenotypic ratios	1
12	Sex determination in animals	1
13	Sex linkage and sex determination in plants	1
14	Linkage and Crossing over: Two point cross, and LOD score	1
15	Linkage problems of three point, complex problems of mapping)	1
16	Maternal effects: inheritance of snell's coiling, pigmentation of flour moth *Kuhniella* and others	1

17	Cytoplasmic inheritance of traits such as variegation in Mirabilis, iojap in maize, streptomycin	1
18	Quantitative genetics: Johanssen's pureline theory, Multiple factor hypothesis, Transgressive Seg	1
19	Inheritance of polygenic traits such as corolla length in N, polydactyl	1
20	Structure of nucleic acids (DNA and RNA)	1
21	DNA Replication	1
22	Function of genes: transcription and genetic code	1
23	Translation for protein synthesis	1
24	Mutation: mutagen, classification and application of the mutation	1
25	Chromosome structural aberration: Duplication, Inversion, Deletion, Translocation	1
26	Chromosome number aberration: Autopolyploidy, Aneuploidy, Allopolyploidy and uses	1
27	Transposable genetic elements	1
28	Prokaryotic gene regulation: Lac operon, its transcriptional and post-transcriptional regulation	1
29	Trp operon: Its transcriptional and post-transcriptional regulation	1
30	Population, Hardy-Weinberg Law and Equilibrium	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Study of diagrams of meiosis	1
2	Study of diagrams of mitosis	1
3	Study of meiotic metaphase	1
4	Solve problems of segregation	1
5	Solve problems of independent assortment	1
6	Solve problems of hypothesis testing to conclude phenotypic ratios	1
7	Illustrations and problems of gene interaction	1
8	Solve problems of linkage (two-point cross)	1
9	Solve problems of LOD score	1
10	Problems of linkage (three point cross)	1
11	problems of probability	1
12	Problems of sex linkage	1
13	Construction of three dimensional picture of DNA using gypsum	1
14	Cytoplasmic & nuclear hereditary materials: genetics of male-sterility	1
15	Genetics of grain yielding traits of rice, wheat and maize	1
	Total	**15**

References

Dabholkar, A.R.1999. Elements of biometrical genetics. Concept Pub. Company, New Delhi, India.

Gardner, E.J., M.J. Simmons and D.P. Smutad, 2011. Principles of genetics (8th ed.). John Wiley and Sons Pvt. Ltd. Singapore.

Griffiths, A.J.F., S.R. Wessler, S.B. Carroll and J. Doebley. 2012. An introduction to genetic analysis (10th ed.). W.H. Freeman and Company, New York. USA.

Singh, B.D. 2007. Fundamentals of genetics (3rd Ed.). Kalyani Publishers, India.

Strickberger, M.W. 2012. Genetics (3rd ed.) PHI Learning Pvt. Ltd., New Delhi, India.

Course Code : PLB 211

Course Title : Principles and Practices of Plant Breeding

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course is designed to help students to build up concepts, principles and methods of plant breeding.

Syllabus

Scope, history, principle, methods of breeding crops, mode of reproduction, phenomena of acclimation, biometrical techniques of qualitative and quantitative traits, principles and methods of plant breeding, such as domestication, plant introduction, selection methods for self-pollinated crops, inheritance of qualitative and quantitative traits, genetics and breeding of biotic resistance, abiotic tolerance, breeding of some self-pollinated crops, seeds and plant breeders' intellectual rights.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction to Plant breeding (definition, history, objectives, activities)	1
2	Introduction to Plant breeding (activities, achievements and consequences)	1
3	Domestication, plant introduction, acclimation	1
4	Germplasm: Germplasm collection	1
5	Centers of diversity, NI Vavilov's Homologous series of variation	1
6	Reproduction, modes of pollination,	1
7	A variety of self incompatibility, a variety of sterility and their actions	1
8	Heterosis, Hypotheses to explain heterosis	1
9	Qualitative and quantitative trait analysis through inheritance study	1
10	Biometrical techniques in plant breeding: assessment of variability, aids to selection	1
11	Aids to selection: genetic gain	1
12	Selection principles of self-pollinating crops: Progeny test, pure line theory, genetic variation	1
13	Mating system	1
14	Hybridization techniques and consequences	1
15	Breeding methods of self-pollinating crops: Mass selection, pure line, multiline	1
16	Breeding methods of self-pollinating crops: Bulk method, Single seed descent	1
17	Breeding methods of self-pollinating crops: Pedigree	1
18	Transfer of gene by backcross method	1
19	Backcross, isogenic lines, near isogenic lines, pyramid lines	1
20	Revision of population genetics: population, gene frequency, Hardy-Weinberg Equilibrium Law	1
21	Crop improvement methods of self-pollinating crops specially rice and wheat	1
22	Genetics of disease resistance and breeding for the disease resistance 1	1
23	Genetics of disease resistance and breeding for the disease resistance 2	1
24	Abiotic stress physiology of chilling and breeding for the chilling stress tolerance	1
25	Physiology of cold tolerance stress and breeding for the cold tolerance	1
26	Physiology of heat stress and breeding for the heat stress tolerance	1
27	Physiology of drought stress and breeding for the drought stress	1
28	Seeds: classes of seeds, quality of seeds	1
29	Intellectual property right and its kinds	1
30	National and international plant breeding organizations	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Drawing and study of gross floral morphology, flowering and crossing procedure in rice	1
2	Drawing and study of gross floral morphology, flowering and crossing in maize	1
3	Drawing and study of gross floral morphology, flowering and crossing in wheat	1
4	Drawing and study of floral parts and crossing in tomato	1
5	Heritability estimation	1
6	Scoring and determining disease resistance, tolerance, sensitivity & susceptibility	1
7	Problems for self-incompatibility and male sterility	1
8	Breeding procedures of NARC in important crops of Nepal	1
9	Plant breeding data recording, some types of data-sheets for plant breeders	1
10	Estimation of heterosis	1
11	Path analysis for crop grain yield of cereal crops	1
12	Estimation of inbreeding depression	1
13	Determining genetic purity of seeds	1
14	Techniques of participatory plant breeding and PVS	1
15	Breeding objectives and research activities in NRRP/NMRP/ NWRP/ NGLRP	1
	Total	**15**

References

Chopra, V.L. 2000. Plant Breeding: theory and practices (2nd ed.) Baba Barkha Nath Printing Press, New Delhi, India.

Dabholkar, A.R.1999. Elements of biometrical genetics. Concept Pub. Company. New Delhi, India.

Gupta, S. K. 2003. Plant breeding: Theory and Techniques. Agrobios. India.

Singh, B.D. 2007. Plant breeding principles and methods (7th ed.) Kalyani Pub., New Delhi, India.

Sleper D.A. and J.M. Poehlman. 2006. Breeding Field Crops (5th Ed.). Panina Publishing Corporation, New Delhi, India.

Course Code : **PLB 321**

Course Title : **Molecular Genetics and Bioinformatics**

Credit Hour : **2 (2+0) Full Mark: 50 Theory: 50 Practical: 00**

Objectives

This course is designed to help students develop understanding of latest scientific research paper in genetics and plant breeding and to make ideas for future planning and strategies formulation from the concepts.

Syllabus

Trait analysis, population genetics; heterosis phenomena, molecular aspects of gene through recombination of mutants of rII locus, genetics, molecular markers, nature of genes, science of inheritance of oligogenic and polygenic traits, molecular aspects of gene, quantitative trait and loci, population genetics, DNA marker technologies, variety of nucleic acid manipulation techniques to extraordinarily exploit for characterization, exploration and engineering of genes through isolation, DNA hybridization with DNA, polymerase chain reaction, DNA fingerprinting, restriction fragment length polymorphism (RFLP), mapping, gene library, DNA microsatellite, bioinformatics,RNA interference and population genetics.

Outline

Theory

S.N.	Topic	No. of lecture
1	Review of inheritance of continuous traits such as grain yield, polygenic inheritance	1
2	Quantitative trait loci (QTL)	1
3	QTL for grain yield of rice	1
4	QTL for grain yield of maize	1
5	Population genetics: Gene pool, gene frequency, Hardy-Weinberg (H-W) Law and equilibrium	1
6	Validation, Hypothesis testing on H-W Equilibrium, Factors affecting H-W equilibrium	1
7	Heterosis: Theories of heterosis and isozyme analysis	1
8	Inbreeding coefficient and inbreeding depression	1
9	Evidence of fine structure of Genes: complementation, Recombination	1
10	Explanation fine structure of gene based on rII locus/ loci	1

11	Review of DNA structure and DNA Replication	1
12	Review of Protein Synthesis, Reverse Transcription	1
13	DNA Manipulation: Properties of Nucleic acids, DNA extraction, Isolation	1
14	Cloning DNA, Restrictase, DNA polymeriase, RNA polymerase	1
15	Vectors: a variety of vectors and vector molecules, virus, bacteria, yeast	1
16	Gene cloning and organism cloning	1
17	Genomic DNA or DNA Library, Gene Library or cDNA library	1
18	Southern blotting, Southern Hybridization, Northern blotting and hybridization	1
19	Nucleic acid Hybridization: DNA x DNA hybridization, RFLP	1
20	Nucleic acid Hybridization: DNA x RNA hybridization, in situ hybridization	1
21	Polymerase chain reaction (PCR), Random Amplified Polymorphic DNA (RAPD),	1
22	Amplified Fragment Length Polymorphism (AFLP)	1
23	DNA Microsatellite, Single Nucleotide Polymorphisms (SNPs)	1
24	DNA Microarray technology	1
25	DNA fingerprinting or DNA Profiling	1
26	DNA sequencing and its methods, Genomics, analysis of gene expression	1
27	Genome, Proteome and Databases	1
28	RNA interference: gene silencing	1
29	Gene regulation in eukaryotes: chromatin structure modification	1
30	CRISPR/Cas Genome Editing Technology	1
	Total	**30**

References

Dabholkar, A.R. 1999. Elements of biometrical genetics. Concept pub. Com. New Delhi, India.

Gardner, E.J., M.J. Simmons and D.P. Smutad. 2011. Principles of genetics (8th ed.). John Wiley and Sons Pvt. Ltd., Singapore.

Griffiths, A.J.F., S.R. Wessler, S.B. Carroll and J. Doebley. 2012. An introduction to genetic analysis (10th ed.) W.H. Freeman and Company, New York, USA.

Hichey G.I. , H.L. Fletcher and P. Winter. 2010. Genetics (3rd ed.). Taylor & Francis, USA.

Singh, B.D. 2007. Fundamentals of genetics (3rd ed.). Kalyani Publishers. India.

Strickberger, M.W. 2012. Genetics (3rd ed.) PHI Learning Pvt. Ltd. New Delhi, India.

Course Code : PLB 421

Course Title : Modern Plant Breeding and Biotechnology

Credit Hour : 2 (2+0) Full Mark: 50 Theory: 50 Practical: 00

Objectives

This course is designed to help students build strong concept of modern principles, methods of plant breeding and foundation science.

Syllabus

Modern plant breeding, evolution of some major crops, centers of diversity, gene pool, its utilization through mating, selection methods, response of selection and breeding methods, breeding of cross-pollinated crops, clonal crops, hybrid breeding, molecular plant breeding through mutation breeding, distance breeding, heteroploidy, a variety of plant tissue culture and their applications, a variety of gene transfer technology into host cells and crop plants and principles and methods of marker-assisted selection breeding, strengthen the above mentioned areas of plant breeding, and cloning of genes.

Outline

Theory

S.N.	Topic	No. of lecture
1	Scope of modern plant breeding	1
2	Evolution of crops and crop germplasms, collection and conservation	1
3	Centers of origin, Centers of diversity, gene pool	1
4	Mating systems	1
5	Selections and their responses in cross-pollinating crops: Types of response to selection	1
6	Breeding cross-pollinating crops: population improvement: mass selection, ear to row selection	1
7	Breeding methods: Simple Recurrent Selection	1
8	Breeding methods: RS, RS for GCA, RS for SCA	1
9	Reciprocal RS	1
10	Hybrids: Principles and method of hybrid cultivar production technology, synthetics, composites	1
11	Synthetics and Composites	1
12	Breeding clonal crops	1
13	Mutagenesis: Generating mutations,	1
14	Mutation breeding for oligogenic and polygenic traits	1

15	Heteroploidy: Aneuploidy, Euploidy, autoploidy, alloploidy, applications in plant breeding	1
16	Autoploidy and application in plant breeding	1
17	Distance breeding and plant chromosome engineering,	1
18	Alien chromosome segment insert from *Aegilops umbellulatum* and wild species, GISH	1
19	Improvement of crops in Nepal: emphasis in maize	1
20	Improvement of crops in Nepal: emphasis in cross pollinating crops	1
21	Cloning: Gene cloning, organism cloning emphasizing engineered sheep: Dolly	1
22	Review of Molecular markers: DNA hybridization and PCR based markers	1
23	Plant Tissue culture Technique, Application	1
24	Meristem culture, anther culture	1
25	Protoplast fusion, protoplast culture, Somaclonal variation	1
26	Gene transfer technologies: Direct DNA Uptake, Electroporation, Particle gun, Microinjection	1
27	*A. tumefaciens* mediated gene transfer technology	1
28	Marker-assisted selection breeding	1
29	Genotype x Environment Interaction estimation and cultivar stability	1
30	Speed plant breeding	1
	Total	**30**

References

Bertrand C. Y. Collard and David J. Mackill. 2008. Marker-assisted selection: an approach for precision plant breeding in the 21st century. Philosophical transactions of the Royal Society.

Chopra, V.L. 2000. Plant breeding: theory and practices (2nd Ed.). Baba Barkha Nath Printing Press, India.

Griffiths, A.J.F., S.R. Wessler, S.B. Carroll and J. Doebley. 2012. An introduction to genetic analysis (10th Ed.). W.H. Freeman and Company, New York, USA.

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Ignacimuthu. S. 1996. Basic biotechnology. Tata McGraw Hill Publishing Company Ltd. India.

Mascarenhas, A.F. 1997. Handbook of plant tissue culture. ICAR, New Delhi, India.

Pareek L.K. and P. L. Swarnkar. 1997. Trends in plant tissue culture and biotechnology. Agro botanical publishers, India.

Singh, B.D. 2007. plant breeding principles and methods (7th Ed.). Kalyani Pub., New Delhi, India.

Sleper D.A. and J.M. Poehlman. 2006. Breeding field crops (5th Ed.). Panina Publishing Corporation, New Delhi, India.

3.12 Plant Pathology

Course Code : PLP 121

Course Title : Introduction to Plant Pathology

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course will enable the students to understand the basic principles of plant pathology, explain the reoccurrence and spread of the plant pathogens and identify the major causal organisms (fungi, bacteria and nematodes).

Syllabus

Basic understanding on causes, general symptoms of plant diseases, fungal pathogens, their characteristics, classification, major genera of pathogenic fungi and their reproduction. Characteristic of bacterial pathogens, nematodes, viruses and other pathogens. Principles of plant pathology, survival and dissemination of pathogens and host defense mechanisms. Principles of plant disease management, chemical and integrated plant disease management, national legislation and authorities for plant disease management.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction, definition of plant pathology and plant diseases	1
2	Causes, classification and general symptoms of plant diseases	1
3	Definition, importance and general morphological characters of fungi	1
4	Asexual and sexual reproduction and types of fruiting bodies in fungi	1
5	Classification of fungi with their diagnostic characters	1
6	Myxomycota: *Plasmodiophora* , *Spongospora* and *Synchytrium*	1
7	Mastigomycotina: *Pythium, Phytopthora and Albugo*	1
8	Mastigomycotina: *Sclerospora, Plasmopara and Peronospora*	1
9	Ascomycotina: *Taphrina, Protomyces, Erysiphe and Claviceps*	1
10	Basidiomycotina: *Puccinia, Melampsora* and *Uromyces*	1
11	Basidiomycotina: *Ustilago and Tilletia*	1
12	Deuteromycotina: *Colletotrichum*, *Alternaria*, *Cercospora* and *Fusarium*	1
13	Deuteromycotina: *Helminthosporium*, *Pyricularia*, *Sclerotium*, *Sclerotinia* and *Rhizoctonia*	1

14	Definition of bacteria, general morphology of a bacterial cell and functions of cell organnels	1
15	Classification of plant pathogenic bacteria (including fastidious vascular bacteria and mollicutes)	1
16	General characteristics of *Xanthomonas, Pseudomonas, Ralstonia, Ewrinia, Agrobacterium, Corynebacterium and Streptomyces*	1
17	Virus & viroids: definition, general characters**,** multiplication and transmission	1
18	General Characteristics, life cycle and reproduction of nematode	1
19	Characteristics of *Anguina, Heterodera, Meloidogyne and Hirshmanella*	1
20	Pathogenicity and pathogenesis	1
21	Survival and disseminations of plant pathogens	1
22	Epidemiological study and disease forecasting	1
23	Pre-exposed and post-exposed defense mechanisms of host	1
24	Host plant resistance: gene for gene interaction, horizontal and vertical resistance, acquired resistance and hypersensitivity	1
25	Physiology of infected plants	1
26	Enzymes and microbial toxins. Definition and history of mycotoxins, their harmful effects, contamination of agricultural products and mitigation strategies in general	1
27	Principles and methods of plant disease management	1
28	Fungicides, their classification and mode of action	1
29	Integrated disease management	1
30	National legislation and authorities for plant disease management: plant protection directorate and plant quarantine	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Laboratory equipments and their handling: Microscopes, Autoclave, Ovens, Incubator, Laminar flow and related equipments	1
2	Cleaning and sterilization of glassware and lab safety measures	1
3	Identification of lower fungi based on their morphological structures: *Mucor, Rhizopus, Pythium* and *Phytopthora*	1
4	Identification of higher fungi based on their morphological structures: *Protomyces, Erysiphe, Puccinia* and *Ustilago*	1
5	Identification of fungi imperfecti based on their morphological structures: *Helminthosporium*, *Pyricularia*, *Alternaria*, *Cercospora*, *Colletorrichum* and *Fusarium*	1
6	Preparation of culture media for fungi	1

7	Isolation of fungi from diseased plants	1
8	Isolation of fungi from soil	1
9	Preparation of culture media for bacteria	1
10	Isolation of bacteria from symptomatic plant tissue	1
11	Identification of Gram-positive and Gram-negative bacteria (Gram's staining and KOH test)	1
12	Inoculation of plants with pathogenic fungi and bacteria	1
13	Extraction of nematodes from soil and infected plant samples	1
14	Identification of pathogenic and saprophytic nematodes	1
15	Market survey (local) for available chemicals and bio-agents used in plant disease management	1
	Total	**15**

References

Agrios, G.N. 2005. Plant pathology. Elsevier Academic Press, New York, USA. London, UK. 922 pages.

Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory mycology (4th Ed.). Wiley, NewYork.

Chaube, H.S. and R. Singh 2001. Introductory plant pathology. Int. Book Dist. Co. Lucknow, India.

Singh, R.S. 1999. Introduction to principles of plant pathology. Oxford & IBH. Pub, New Delhi.

Course Code : PLP 211

Course Title : Crop Diseases and Management

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

This course will enable the students to differentiate the plant diseases caused by fungi, bacteria, viruses, nematodes and abiotic factors, identify the major causal organisms of plant diseases, explain the reoccurrence and spread of the diseases in the field and to suggest the control measures of major plant diseases.

Syllabus

Fungal diseases: powdery mildews, downy mildews, damping off of seedlings, root rots, collar rots, rusts, smuts, wilts, blights, blast, leaf spot, anthracnose, malformation, die-back and white rust. Bacterial diseases: leaf blight, leaf streak, wilt, angular leaf spot, canker and brown rot. Nematological diseases: root knot, ear cockle and white tip. Viral and mycoplasmal diseases: mosaics, bunchy top, tristeza and little leaf. Abiotic diseases: tip burn, black heart, black tip and Khaira.

Outline

Theory

S.N.	Topic	No. of lecture
1	Powdery mildew of pea, cucurbits and wheat	1
2	Powdery mildew of apple and citrus	1
3	Downy mildew of maize and grape	1
4	Downy mildew of crucifers and cucurbits	1
5	Damping off of seedlings and stem rot of jute	1
6	Collar rot of apple, citrus and papaya	1
7	Rusts of wheat, pea and beans	1
8	False smut of rice, loosesmut and bunt of wheat and covered smut of barley	1
9	Wilt of guava, cotton, arhar, lentil and chickpea	1
10	Leaf spot and blast of ginger, leaf blotch of turmeric and rhizome rot of ginger and turmeric	1
11	Late blight and early blight of potato and tomato and *Alternaria* leaf spot of crucifers	1
12	Blast, leaf spot and sheath blight of rice and leaf blotch of wheat	1
13	Anthracnose and malformation of mango	1
14	Anthracnose of bean, die-back and leaf spot of chilli and leaf spot of groundnut	1
15	Stem gall of coriander, peach leaf curl and stemphylium leaf blight and purple blotch of onion and garlic	1
16	Sclerotinia disease of leguminous, cruciferous and solanaceous crops and white rust of crucifers	1
17	Red rust of tea and litchi and rust of guava and coffee	1
18	Bacterial leaf blight and leaf streak of paddy and angular leaf spot of cotton	1
19	Black rot and clubroot of crucifers	1
20	Canker, greening and tristeza of citrus	1
21	Fire blight of apple, brown rot of potato and moko disease of banana	1
22	Root knot of vegetables and rice, white tip of paddy and ear cockle of wheat	1

23	Northern leaf blight, southern leaf blight and stalk rot of maize	1
24	Grey leaf spot and banded leaf and sheath blight of maize	1
25	Yellow vein mosaic of okra, tobacco mosaic, tomato mosaic and papaya ringspot	1
26	Bunchy top of banana and viral disease of potato	1
27	Bean common mosaic, soybean mosaic, cucumber mosaic and zuccunii yellow mosaic	1
28	Little leaf of brinjal and chilli, chirke and furke disease of cardamom	1
29	Tip burn of paddy, black heart of potato, Khaira disease of rice, black tip of mango, whiptail of cauliflower, blossom end rot of tomato and hollow heart of cauliflower	1
30	*Orobanche*, *Cuscuta* (Dodder), *Viscum* (mistletoe*)* and *Striga*	1
	Total	**30**

Practical

S.N.	Topic	No. of practical
1.	Field visit to identify fungal, bacterial, viral, nematodal and abiotic diseases of crops	1
2	Collection and preservation of disease specimens	1
3	Teasing and preparation of temporary slides:	
	3.1 lower fungi: *Phytopthora, Sclerospora, Peronospora and Plasmopara*	1 1
	3.2 higher fungi: *Erysiphe, Puccinia* and *Ustilago*	1
	3.3 fungi imperfecti: *Helminthosporium*, *Pyricularia*, *Alternaria*, *Cercospora*, *Colletorrichum* and *Fusarium*	
4	Identification of spores: loose smut of wheat, false smut of rice and bunt of wheat	1
5	Transverse section cutting of disease specimens to study host parasite relationship of:	1
	5.1 *Albugo and Protomyces*	1
	5.2 *Puccinia, Uromyces* and *Hemilia*	1
	5.3 *Colletotrichum, Alternaria* and *Cercospora*	1
	5.4 *Helminthosporium* and *Pyricularia*	
6	Ooze test for bacterial infection	1
7	Study of root knot nematode (diseased root samples, eggs and juveniles)	1
8	Dilution of chemicals	1
9	Handling and calibration of sprayers	1
10	Preparation of Bordeaux mixture and paste	1
	Total	**15**

References

Agrios, G.N. 2005. Plant pathology. Elsevier Academic Press, New York, USA.

Mehrotra, R.S. and A. Agrawal. 2003. Plant pathology (2nd Ed.). Tata MCGraw-Hill Publ. India.

Singh, R. S. 2005. Plant diseases (8th Ed.). Oxford and IBH Publishing Co. Pvt.Ltd. India.

Course Code : PLP 411

Course Title : Mushroom Cultivation

Credit Hour : 1 (0+1) Full Mark: 00 Theory: 25 Practical: 25

Objectives

This course will enable the students to understand the biology and cultivation scheme of button mushroom, oyster mushroom, straw mushroom and shitake mushroom along with classification and general biology of other mushroom species.

Syllabus

Definition, importance and classification of mushroom, distinguishing characters of poisonous and edible mushrooms. Morphological characters of *Pleurotus, Volvariella, Agaricus, Lentinula and Ganoderma.* Media preparation, isolation and maintainance of pure culture. Spawn preparation and cultivation scheme of *Pleurotus, Lentinula* and *Agaricus.*

Outline

Practical

S.N.	Topic	No. of practical
1.	Definition, importance and classification of mushroom	1
2	Media preparation, isolation of mushroom from tissue (gills)	1
3	Preparation of pure culture of mushroom and its maintenance	1
4	Preparatory work for grain spawn production (cleaning, washing, boiling and amendments addition)	1
5	Sterilization and incubation of grains for spawn production	1
7	Collection and preparation of substrates for oyster mushroom cultivation	1

8	Incubation and maintenance of substrate packages	1
9	Opening of substrate packages and environmental management	1
10	Harvesting, grading and packaging of mushroom	1
11	Preparations for button mushroom cultivation	1
12	Turnings of substrate and caring	1
13	Sprawning of compost, and sterilization of casing soil	1
14	Harvesting of mushrrom beds	1
15	Visit to local mushroom cultivation farm and report writing	1
	Total	**15**

References

Chandra, R. 2016. Mushroom production technology. Banaras Hindu University, Varanasi, India.

Datta, S. M. and S.V. Ngachan. 2012. Mushrooms: manual for cultivation. PHI Learning, India.

Kapoor, J. N. 1989. Mushroom cultivation. ICAR, New Delhi.

Ram, R. C. 2007. Mushrooms and their cultivation techniques. Aavishkar Publication, India.

Course Code : PLP 412

Course Title : Seed Pathology

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

This course will enable the students to differentiate and identify the major seed-borne and seed transmitted fungi, bacteria, nematodes and viruses, test the seed lots and find out the seed infection with seed transmitted pathogens, and explain disease cycles of seed borne pathogens and their control.

Syllabus

Introduction, history , definition of seed pathology, crop loses caused by seed-borne fungi, bacteria, nematodes, viruses, seed borne and seed transmitted fungi, bacteria, nematodes, viruses, disease cycles, techniques for seed health test for fungi, bacteria, virus, nematode and managenent of seed borne pathogens.

Outline

Theory

S.N.	Topics	No. of lectures
1	Introduction, history & definition of seed pathology, seed borne disease and economic significance of seed borne diseases.	1
2	Crop losses caused by seed borne diseases in wheat , rice , maize, barley, oat, sorghum, soyabean, bean, pea, chickpea, groundnut, mustard and vegetables.	1
3	Seed dieases caused by fungi bacteria viruses and nematodes.	1
4	Seed borne and seed transmitted fungi, viruses, bacteria and nematode	2
5	Disease cycles: 5.1 Intraembryal infection followed by systemic infection 5.2 Intra embryal infection followed by local infection. 5.3 extra embryal infection followed by systemic infection 5.4 Extra embryal infection followed by local infection 5.5 Seed contamination followed by systemic infection 5.6 Seed contamination followed by extra metrical sapryophytism or a dormant stage and subsequently by local infection. 5.7 Seed contamination by structures from organ specific seed infections	4
6	Techniques for testing fungal seed health for fungal infection, bacterial and nematode infection, viral infection.	3
7	Mycotoxins and mycotoxicoses: association of mycotoxin producing fungi to various types of seeds, toxin production, detection, harmful effects and reduction in seeds.	2
7	Management of seed borne pathogens	1
	Total	**15**

Practicals

S.N.	Topic	No. of practicals
1	Dry seed observation for seed infection by pathogens	1
2	Washing test for smuts	1
3.	Blotter test for cereals	2
4.	Blotter test for vegetable seeds	1
5.	Blotter test for oil seeds	1
6.	Rolled paper towel method for detection of seed borne pathogens.	1
7.	Freezing method test for detection of seed borne pathogens.	1
8.	Seedling symptom test for detection of seed borne pathogens.	1
9.	Detection of seed borne pathogens by using water agar method.	1
10.	Embryo staining method for study of loose smut pathogen.	1
11.	Study of different seed treatment methods with chemicals.	2
12.	Study of biological seed treatment.	1
13.	Comparison of treated and untreated seeds.	1
	Total	**15**

References

Neegard , P. 1986. Seed pathology (1st ed). S. Chand and Company Ltd. New Delhi, India.

Agrawal V.K and J.B. Sinclair. 1997. Principles of seed pathology (2nd ed). Lewis Publishers

Mathur, S.B. and O. Kongsdal. 2003. Common laboratory seed health testing methods for detectingfungi (1st ed). International Seed testing Association.

3.13 Soil Science And Agri-Engineering

Course Code : SSC 111

Course Title : Fundamentals of Soil Science

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

In pursuing this course, the students will learn the basic knowledge of soil formation in relation to physical and chemical properties of soil along with their management options.

Syllabus

Definition, concept and use of soils; geology in relation to soils-evolution and composition of earth, development of soils; rocks and minerals-origin, classification, distribution and weathering; soil formation; important soil flora and fauna; soil as a medium for plant growth; soil components and soil-plant relationship; physical properties of soils; soil colloids: organic and inorganic colloids and their properties; cation and anion exchange phenomena; silicate clays: composition and properties; soil reaction: pH and measurements, soil acidity and alkalinity, effect of soil pH on nutrient availability, buffering of soils, amendments of acid, saline and sodic soils.

Outline

Theory

S.N.	Topic	No. of lecture
1	Evolution and composition of earth	1
2	Land system, land forms and land units	1
3	Weathering of rocks and minerals and soil forming rocks and minerals	2
4	Basic and pedogenic processes of soil formation	1
5	Concept, definition, scope and branches of soil science	1
6	Historical development of soil science and soil institutions in Nepal	1
7	Facrors affecting soil formation	1
8	Soil as a natural body, ecological functions of soils	1
9	Kinds and distribution of soil flora and fauna	1
10	Physical propertise of soil	
10.1	Soil components	1
10.2	Soil texture and textural classification and its importance	1
10.3	Soil structure: types, class and grades	1
10.4	Formation of soil structure and importance of soil structure	1
10.5	Bulk density, particle density and porosity; and their importance	1
10.6	Soil color and its importance	1
10.7	Soil consistency and its importance	1
11	Chemical properties of soil	

11.1	Properties and types of soil colloids	1
11.2	Fundamental structure of silicate clay and charge development of silicate clays	2
11.3	Mineralogical organization of crystalline silicate clays	1
11.4	Genesis of soil colloids	1
11.5	Ion exchange, ion exchange capacity and its importance	2
11.6	Concept of soil pH and properties of acid soils and buffering capacity of soils	2
11.7	Different pools, causes and effects of soil acidity	1
11.8	Influence of soil pH on nutrient availability and management of acid soils	1
11.9	Properties of salt affected soils	1
11.10	Effects and management of salt affected soils	1
	Total:	**30**

Practical

S.N.	Topic	No. of practical
1	Precautions to be taken while working in soil science laboratory;	1
2	Identification of equipments used in soil science laboratory	1
3	Identification of major soil forming rocks and minerals	1
4	Soil sampling and processing for laboratory analysis	1
5	Soil textures determination by feel method	1
6	Particle size analysis by hydrometer method	1
7	Determination of soil structure	1
8	Determination of soil bulk density	1
9	Determination of particle density and porosity	1
10	Determination of soil color	1
11	Determination of soil consistency	1
12	Determination of soil pH	1
13	Determination of cation exchange capacity of soil	2
14	Determination of electical conductivity of soil	1
	Total:	**15**

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Course Code : SSC 121

Course Title : Soil Physics, Genesis and Classification

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

In pursuing this course, the students will gain basic knowledge of soils in relation to soil physical environment, soil characteristics and their influence on soil and plant growth, study soil profile, classify and map them, and gain the knowledge of different soils of Nepal.

Syllabus

Potential energy of water, its movement across soil-plant-atmosphere continuum and measurement; soil environment and transient conditions affecting water, air and heat flow; infiltration and surface sealing in relation to soil characteristics and effect on plant growth; soil management through structural improvement; land capability classification; role of temperature and moisture regimes in soil classification, a brief account of USDA system of soil classification and FAO/UNESCO systems and soils found in Nepal.

Outline

Theory

S.N.	Topic	No. of lecture
1	Concept, scope and importance of soil physics in agriculture	1
2	Soil water energy concept and soil moisture characteristics curve	1
3	Soil water movement under saturated and unsaturated conditions	1
4	Air and heat movement in soil and infiltration characteristics in soil	1
5	Surface sealing, its effect on soil and crop growth and its management	1
6	Factors affecting soil structure; effect of puddling and farm machineries on structural behavior of soil	1
7	Structural management of arable soil	1
8	Soil profile development	1
9	Surface and subsurface soil horizons	1
10	Soil moisture and temperature regimes	1
11	Soil classification on the basis of USDA soil taxonomy	2
12	FAO/UNESCO soil classification system	1
13	Concept and development of land capability classification	1
14	Major soils found in Nepal and their land uses	1
	Total	**15**

Practical

S.N.	Topic	No. of practical
1	Determination of water holding capacity of soil	1
2	Determination of soil wetness (gravimetric and volumetric water content) and soil water depth	1
3	Volume and mass relationship of soil constituents	1
4	Observation of capillary phenomenon of soils	1
5	Determination of matric potential of soil by tensiometer	1
6	Calculation of water quantities in soil	1
7	Study of soil profile in upland and lowland	3
8	Land capability assessment of nearby farm of campus	2
9	Data acquisition, analysis and interpretation of geographic data	2
10	Preparation of soil maps and report	2
	Total	**15**

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Course Code : SSC 211

Course Title : Soil Fertility Management

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

In pursuing this course, the students will gain basic knowledge of soils in relation to different types of plant nutrients, fertilizers, organic matter and bio-fertilizers and will be able to evaluate the soil fertility status.

Syllabus

Historical development of soil fertility and plant nutrition; plant nutrients: primary, secondary, micronutrients and beneficial nutrients: sources, functions, deficiency symptoms and availability to plant; fertilizers: their composition, uses and behavior in soils; bio-fertilizers and their usages; soil organic matter; types of organic manures and their preparation; green manuring; soil fertility evaluation: visual diagnosis, plant tissue analysis, biological tests and soil tests; integrated nutrient management; soil fertility problems and soil management for sustainable agriculture in Nepal.

Outline

Theory

S.N.	Topic	No. of lecture
1	Historical development of soil fertility and plant nutrition; concept of soil fertility and soil productivity	1
2	Plant nutrients	
2.1	Criteria for nutrient essentiality. classification of nutrients and functions of structural elements	1
2.2	Sources, functions and deficiency symptoms of primary nutrients	2
2.3	Sources, functions and deficiency symptoms of secondary nutrients	2
2.4	Sources, functions and deficiency symptoms of micronutrients	2
2.5	Sources, functions and deficiency symptoms of beneficial nutrients	1
3	Plant fertilizers	1
3.1	Definition and classification of inorganic fertilizers	1
3.2	Compositions, behaviors and use of the nitrogenous fertilizers	2
3.3	Compositions, behaviors and use of the phosphatic fertilizers	2
3.4	Compositions, behaviors and use of the potassic fertilizers	1
4	Decomposition of organic residue	1
5	Organic sources of plant nutrients	

5.1	Farm yard manure, compost, vermicompost, biogas, liquid manure and their preparation and management	2
5.2	Definition, types and use of the bio-fertilizers	2
5.3	Characteristics, use and importance of green manuring crops	1
6	Soil fertility evaluation: visual diagnosis, plant analysis, biological method and soil analysis	2
7	Approaches of fertilizer recommendations	1
8	Integrated nutrient management	
8.1	Concept and importance of integrated nutrient management	1
8.2	Components and steps of integrated nutrient management	1
9	Soil fertility problems and their management in Nepal	1
10	Concept, principles and practices of sustainable soil management	2
	Total	**30**

Practical

S.N.	Topic	No. of practical
1	Preparation of standard and stock solutions	1
2	Identification of deficiency symptoms of plant nutrients in the field and preparation of herbarium	1
3	Estimation of soil organic carbon	1
4	Determination of total nitrogen in soil	2
5	Determination of available phosphorus in soil	2
6	Determination of available potassium in soil	1
7	Heap and pit methods of compost preparation	1
8	Identification of effective root nodules and isolation of *Rhizobium*	1
9	Determination of nitrogen content in urea	1
10	Determination of total nitrogen in compost/FYM	2
11	Determination of available phosphorus in compost/FYM	1
12	Determination of available potassium in compost/FYM	1
	Total:	**15**

References

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Course Code : SSC 311

Course Title : Introductory Soil Conservation and Watershed Management

Course Code : 2 (2+0) Full Mark: 50 Theory: 50 Practical: 00

Objectives

Upon pursuing this course, the students will gain basic knowledge on principles and practices of soil conservation and watershed management.

Syllabus

Concept of soil conservation; hydrology and its related branches, hydrological cycle, importance and human influence; sources of water pollution; soil erosion: mechanics and forms of water erosion, erosivity of rainfall and runoff, types of water erosion; mechanics of wind erosion: processes, factors affecting, control measures; soil erosion monitoring and estimation: simple visual methods, runoff plot, sedimentation survey; consequences of soil erosion: fertility loss, land degradation, floods, landslides, natural hazards, socioeconomic consequences; soil conservation practices; soil erosion control in agricultural lands, forestlands and rangelands; concept of watershed management; approach to soil conservation and watershed management in Nepal: legislation and regulation.

Outline

Theory

S.N.	Topic	No. of lecture
1	Concept of soil conservation	
1.1	Importance of soil conservation	1
1.2	Problems and causes of soil degradation in Nepal	1
2	Hydrology and hydrologic cycle	
2.1	Concept of hydrology and hydrologic cycle; related branches of hydrology	1
2.2	Human influence on hydrologic processes	1
2.3	Significance of hydrologic knowledge in natural resources planning	1
3	Sources of water pollution and control measures	2
4	Mechanics and forms of water erosion	
4.1	Definition of soil erosion	1
4.2	Erosivity of rainfall and runoff	1
4.3	soil erodibility	1
4.4	Concept of landslip, landslide and mass wasting	1
5	Mechanics of wind erosion	
5.1	Wind erosion processes, their observation and assessment	1
5.2	Factors affecting wind erosion	1
5.3	Wind erosion control	1
6	Soil erosion monitoring and estimation	
6.1	Visual methods, runoff plot technique and sedimentary survey	1
6.2	Empirical method	1
7	Consequences of soil erosion	
7.1	On site consequences	1
7.2	Off site consequences	1
7.3	Socio-economic consequences	1
8	Soil conservation practices	
8.1	Soil erosion control measures in agricultural lands	2
8.2	Soil erosion control measures in Forest and Rangelands	1
8.3	Bioengineering measuresof soil conservation	1
8.4	Engineering measures of soil conservation	1
9	Concept of watershed management	
9.1	Definition of watershed and subwatershed and watershed management	1
9.2	Watershed approach in soil and water management	1
9.3	Concept and principles of integrated watershed management	1
9.4	Factors affecting watershed degradation in Nepal	1

10	Approaches to soil conservation and watershed management in Nepal	
10.1	Institutional arrangement for soil conservation and watershed in Nepal	1
10.2	Legislation and regulations related to soil conservation and watershed management in Nepal	1
	Total	**30**

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Course Code : **AEN 221**

Course Title : **Farm Power and Machinery**

Credit Hour : **3 (2+1) Full Mark: 75 Theory: 50 Practical: 25**

Objectives

Upon successful completion of this course, students will be able to know different sources of farm power and their utilization. The students will also learn to operate farm machines for crop production; learn the principle of operation of internal combustion engines; their care and maintenance, understand the operation and control of two-wheeled and four-wheeled farm tractors.

Syllabus

Sources of farm power including human, animal, electrical, mechanical, biogas, micro-hydro, solar and wind; internal combustion engines: two-stroke and four-stroke cycle compression ignition (diesel) and spark ignition (petrol) engines; farm tractors and their management: types and suitability of farm tractors for Nepalese agriculture; tillage and tillage implements: operation and management of primary and secondary tillage implements, cultivators, cultivator tools, specialized tillage implements; sowing and planting machines: seeding mechanics, furrow openers, zero-tillage and reduced seed drills and planters, planting machines; plant protection equipments: manual, power operated and tractor drawn sprayers and duster; harvesting machines: reaper, mower and combined harvester; threshing machines: wheat and rice threshing paddle thresher, multi-crop threshers; farm electricity and electrical machines.

Outline

Theory

S.N.	Topic	No. of lecture
1	Sources of farm power: Availability and limitations of different sources of farm power including human, animal, electrical, mechanical, bio-gas, micro-hydro, solar and wind Assessment of energy demand and supply in Nepalese agriculture, and utilization of non-conventional energy resources in agriculture	2

2	Internal combustion engines: Classification and working principles of two-stroke and four-stroke cycle compression ignition (diesel) and spark ignition (petrol) engines. Components of internal combustion engines and their functions Systems in internal combustion engines (tractor engines) Air cleaning and cooling Fuel supply, lubrication and electrical care Maintenance and trouble shooting of internal combustion engines	6
3	Farm tractors and their management: Types of farm tractors and suitability of farm tractors for Nepalese agriculture Introduction to control system of tractors and their care and maintenance, including power transmission, brake, steering, PTO, differential and hydraulic system Tractor hitch system and hydraulic control	3
4	Tillage and tillage implements: definition and objectives of tillage, changing views on tillage operations, operation and management of primary tillage implements and types of tillage; Operation and maintenance of secondary tillage implements and specialized tillage tools	3
5	Sowing and planting machines: types of seeding machines, metering mechanism for seed and fertilizer in seed drills and planters; Types of furrow openers and planting machines for major crops	2
6	Principles and functions of manual and machine operated sprayers and dusters Nozzles used in sprayers and their selection; Repair, maintenance and safety precautions in handling plant protection equipments	2
7	Harvesting machines for cereals. Working principles and components of reaper, mower and combined harvester; Harvesting equipments for roots and tuber crops	2
8	Classification and working principles of threshers; Components and types of wheat and rice threshing machines; Types of combines	3
9	Working principles of processing machines; Machines for cleaning, sorting and grading of cereals, pulses and vegetables	2
10	Working principle and types of electric motors. Prospects of farm electricity use	1
11	Selection of electric motors for farm use; care & maintenance of electric motors	1
	Seed treatment drum	1
12	Cost of operation of tractors and farm implements	1
13	Selection criteria and performance measures of farm machines and implements	1
	Total:	**30**

Practical

S.N.	Topic	No. of practical
1	Identification and use of repair and maintenance tools	1
2	Identification of machine elements	1
3	Study of country plough and mould board plough	1
4	Study of disk plough	1
5	Study of harrow and cultivators	1
6	Study of rotary tillage tools	1
7	Study of seed drill, planter and their calibration	1
8	Identification, maintenance and calibration of plant protection equipments	1
9	Study of crop harvesting machines	1
10	Study of threshers: multi-crop multi-purpose single and double drum paddle cum electric motor drawn thresher and wheat thresher	1
11	Identification of component parts, maintenance and study of engine systems	2
12	Study of tractor systems, control and maintenance	1
13	Study of traditional water lifting machines and irrigation pumps	1
14	Tractor and power tiller operation	1
	Total:	**15**

References

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Course Code : AEN 311

Course Title : Introductory Agro-meteorology

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

This course will provide 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. This understanding will help the students relate the growth, development and production of crops in relation to weather and climate and thereby make choices of crops and cropping system in the limits of weather and climate and develop system of climate proofing.

Syllabus

Definition, scope and role in agriculture; concept and measurement of solar radiation, air temperature, precipitation, relative humidity, wind, soil, moisture and temperature, evaporation and transpiration; modern sensors for measuring climate variables; climatic normal of important crops; drought and climate change; forecasting of climate; benefits of remote sensing and geographic information systems (GIS) and its application in agriculture and use of the models in agro-meteorology

Outline
Theory

S.N.	Topic	No. of lecture
1	Definition, scope and role of meteorology in agriculture	1
2	Concept of weather and climate; climatic classifications- Koppens classification, Thronthwaite classification and climates of Nepal	1
3	Solar radiation (solar intensity, duration, quality and photo synthetically active radiation) and net radiation	1
4	Air temperature, precipitation, humidity, wind speed, direction and measurement Soil moisture, soil temperature and their measurement	2
5	Evaporation, transpiration and factors affecting evapotranspiration	1
6	Agrometeorlogical normals for different crops	1
7	Sensors for measurement of agro-meteorological variables (air temperature, relative humidity, solar radiation, precipitation, soil moisture, soil temperature, atmospheric pressure, wind speed and direction)	2
8	Agroclimatic regionalization; crop zones and agro-climatic zones of Nepal	1
9	Climate change and its impacts on agriculture:	1
10	Elements of agricultural weather forecast; weather based agricultural advisory; types of weather forecasts: short, medium and long range and their usefulness	2

11	Definition of remote sensing (RS), reflective RS, thermal RS, microwave RS, earth satellites, weather satellite; assessment of meteorological and agronomic conditions to aid decisions on drought using remote-sensing, introduction to geographic information systems (GIS) and its application in agriculture.	2
	Total:	**15**

Practical

S.N.	Topic	No. of practical
1	Study of meteorological observatories, site selection and layout Use of maximum and minimum thermometer	1
3	Measurement of maximum, minimum temperatures and soil temperature using digitial instrument	2
4	Measurement of rainfall and evaporation measuring instruments	1
5	Measurement of wind speed and wind direction and preparation of	1
6	wind rose	1
7	Determination of vapour pressure, relative humidity and dew point temperature Measurement of solar radiation: bright sunshine hours, total shortwave and long wave radiation estimation	1
8	Exposure and location needs of weather station; and automated weather station	1
9	Crop water requirement and crop coefficients with seasonal crop	2
10	Use of CROPWAT in estimation of crop water and irrigation requirements and irrigation scheduling.	2
11	Estimation of Potential Evapotranspiration	1
12	Analysis of rainfall data for climatological studies	1
13	Estimation of heat units with reference to a sample crop	1
	Total:	**15**

References

Mahi, G.S. and P.K. Kingra. 2014. Fundamental of agrometeoroloy. Kalyani Publishers, India.

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Course Code : AEN 411

Course Title : Principles and Practices of Irrigation Management

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

Upon completion of this course, the students will know the importance of irrigation for agricultural intensification and productivity enhancement; determine the depth of irrigation and schedule the irrigation, learn the basic design principles of farm irrigation methods; layout and designing of open channel and water measurement of canal water; wells and pumps and drainage methods for water logged field.

Syllabus

Definition, objectives and, roles of irrigation in agriculture; climatic condition and water resource potential of Nepal; soil moisture constants, infiltration, critical stages of crops and moisture extraction pattern; crop water requirement: evapotranspiration (consumptive use), field water losses; irrigation scheduling: objectives and strategies, soil, plant and climatic indicators; farm irrigation: methods, suitability, adaptability and comparative advantages of irrigation methods; field drainage systems: water logging and need of drainage, irrigation wells and pumps.

Outline

Theory

S.N.	Topic	No. of lecture
1	Introduction:	3
1.1.	Definition and objectives of irrigation, advantages and disadvantages of irrigation, environmental impacts of irrigation.	
1.2.	History of irrigation development in Nepal	
1.3.	Water resource potential of Nepal; role of irrigation for the development of agriculture in Nepal and types of irrigation systems in Nepal	
2	Soil-water-plant relationship:	3
2.1.	Classes of soil water, apparent specific gravity and soil water availability	
2.2.	Soil moisture extraction pattern by depth and critical stages of crops with respect to soil moisture	
2.3.	Infiltration, percolation, intake rate, permeability, hydraulic conductivity, seepage and inflow.	
3	Evapo-transpiration (ET),	2
3.1.	Definition, consumptive use rate; estimation of ET by Lysimeter and Evapometer	
3.2.	Estimation of ET by Penman, Blaney, Criddle and Christiansen methods and Thornthwaite formula	
4	Crop water requirement	3
4.1.	Factors affecting the crop water requirement; base period; paleo irrigation, kor watering, effective rainfall and intensity of irrigation	
4.2.	Determination of crop water requirement by transpiration ratio method, depth-interval-yield method, soil moisture depletion method & field experiment method	
4.3.	Estimation of consumptive use by using drum culture technique for rice, Duty and Delta of water	
5	Irrigation scheduling	7
5.1.	Depth and frequency of irrigation; irrigation requirement and numerical problems	
5.2.	Soil, plant and climatic indicators for irrigation scheduling; crop planning and farmers methods for irrigation scheduling	
5.3.	Surface irrigation methods: check basin, ring basin, border strip and contour farming. Merits and demits of surface irrigation methods	
6	Surface irrigation methods:	
6.1	Parameters and features of furrow and corrugation methods and merits and demerits of furrow irrigation methods	

6.2	Sub-surface irrigation methods: layout and components of sub-surface irrigation system, merits and demerits of sub-surface irrigation methods	
6.3	Drip irrigation methods: layout and components of drip irrigation system, and merits and demerits of drip irrigation methods	
6.4	Sprinkler irrigation methods: layout and components of sprinkler irrigation system, pump capacity requirement, sprinkler spacing and nozzle discharge	
6.5	Classification of sprinkler irrigation system and merits and demits of sprinkler irrigation methods	
6.6	Newly developed micro-irrigation techniques: Cabligation and Surge flow irrigation method	
6.7	Performance of irrigation methods: efficiency, application uniformity, adequacy and effectiveness of irrigation; and numerical problems	
7	Canals:	4
7.1	Designing and calculation of an open channel	
7.2	Water control structures: check gates, turnouts, siphons and division boxes	
7.3	Erosion control structures: open drop and pipe drop structures. Channel crossing structures: flume, inverted siphon and culverts	
7.4	Measurement of irrigation water: weir, flumes and orifices, and float methods	
8	Irrigation wells and pumps:	4
8.1	Definition, aquifer, recharge area, piezometric surface, dug well and tube well	
8.2	Types of Irrigation pumps: reciprocating pumps and centrifugal pumps and working principle and types of centrifugal pumps.	
8.3	Turbine, propeller and airlift pumps	
8.4	Selection of irrigation pumps; pump performance, characteristic curves, affinity laws, specific speed and numerical problems	
9	Drainage engineering:	2
9.1	Water logging and its effects, causes of water logging; critical water logging duration, drainage depth and drainage coefficient	
9.2	Design criteria of surface open drains and closed drains	
10	Reclamation of problematic soils: suitability and criteria of irrigation water; reclamation of saline, sodic and saline-sodic soils	2
	Total:	**30**

Practical

S.N.	Topic	No. of practical
1	Measurement of soil moisture by using: Gravimetric method and Tensiometer	1
	Feel and appearance method and soil moisture meter	1
2	Determination of soil moisture constants: saturation capacity (SC) and field capacity (FC)	1
	Permanent wilting point (PWP) and ultimate wilting (UW)	1
3	Measurement of infiltration capacity of soil: use of double ring Infiltrometer	1
	Use of A.N. Kostiakov's formula and determination of its characteristic constants using method of averages	1
4	Determination of evapotranspiration by using climatic data: Use of Penman's method	1
	Use of Blaney-Criddle method	1
	Use of USWB class A pan evapometer and lysimeter	1
5	Study and design of different farm irrigation methods: furrow, check basin, border strip, ring basin, sub-surface, drip and sprinkler irrigation methods	1
	Some newly developed irrigation methods	1
6	Assessment of field water losses, seepage, percolation and runoff and evaluation of water application efficiency, water storage efficiency and distribution efficiency	1
7	Measurement of flow of water in an open channel by using: Float method	1
	Flow measuring devices: weirs, flumes and orifices	1
8	Field visit to observe irrigation and drainage systems, irrigation projects, lift irrigation, on farm irrigation structures, head works etc	1
	Total	**15**

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Course Code : AEN 421

Course Title : Farm Structure and Surveying

Credit Hour : 2 (1+1) Full Mark: 50 Theory: 25 Practical: 25

Objectives

In pursuing this course, the students will acquire knowledge and skills of land measurement, surveying, leveling, layout of farm and animal shelter and storage and ancillary structures.

Syllabus

Surveying: definition, scale; chain survey: linear measurements; survey stations and lines, offset, obstacles in chaining: compass survey: types, bearing, compass traversing, local attraction; leveling: leveling instrument, methods of entering levels in the field book: line of collimation and rise and fall method. Land leveling design; topographic map; farm structures: construction materials; planning and functional requirements of dairy cattle shed, poultry house, swine stall; design of feed, fodder and grain storage structures; estimation and costing of farm structures quantity estimate and rate analysis.

Outline

Theory

S.N.	Topic	No. of lecture
1	Surveying: classification, and principle of surveying; engineer's and graphical scale; map and plan and numerical problems	1
2	Chain surveying: ranging, survey stations, survey lines, offsets, obstacles in chaining, field book and plotting map and numerical problems	1
3	Compass survey: types of compass and bearing; local attraction; open and close traversing and numerical problems	1
4	Leveling: objective of leveling and methods of entering levels in the field book; collimation system, rise and fall system and numerical problems	1
5	Structural materials: clay, brick, water, cement, sand, gravel, mortar, concrete and concrete mix design in making farm structures	1
6	Estimating and costing:	2
6.1	Approximate and detailed estimation	
6.2	Procedure of preparing detail estimate of agricultural structures	

7	Types and features of farm buildings:	2
7.1	Load bearing and framed structure; building shapes	
7.2	Building components: foundation, walls and pillars, openings (door and windows), floor, bands (plinth, lintel and gable) , roof and cantilever	
8	Shallow foundation	2
8.1	Foundation for load bearing building: size of shallow foundation and bearing capacity of foundation	
8.2	Earthwork, soling, DPC: dampness and its' effect and prevention, RCC,PCC, plastering, skirting, curing, centering and shuttering and painting	
9	Planning, layout, types and functional requirement of:	4
9.1	Dairy cattle house and stanchion barn	
9.2	Poultry house for deep litter housing	
9.3	Feed and grain storage structure	
9.4	Fodder storage structures the silo	
	Total	**15**

Practical

S.N.	Topic	No. of practical
1	Linear measurement: Chain and tape survey, prepare a field book and plot a map	1
2	Compass survey: open and closed traversing	1
3	Measurement and calculation of Area of: a) Closed traversing made by chain and compass surveying and b) Plan or map by using graphical and instrumental method	1
4	Profile leveling	1
5	Grid leveling for contouring	1
6	Estimation of earthwork by cut and fill method	1
7	Concept of orthographic projection	1
8	Designing of Stanchion (tail to tail and head to head) cow shed	1
9	Designing of Free stall cattle shed and Loose barn	1
10	Designing of deep litter poultry house	1
11	Designing of swine stall	1
12	Designing of grain storage structure and study of indigenous local grain storages	1
13	Calculation and estimation of structures materials	1

14	Estimate and costing of quantity of work done in keeping foundation of load bearing building by using separate wall method: earthwork, footings, plinth, DPC and superstructures	1
15	Estimating and costing of a frame structure building construction	1
	Total	**15**

References

Kaanetkan, T.P. and S.V. Kulkami. 1990. Surveying and levelling (V. I & II). Vidyarthi Griha Prakasan, India.

Michael, A.M. and T.P. Ojha. 2003. Principles of agricultural engineering (V. II). Jain Brothers, New Delhi, India.

Punmia, B.C. 1983. Surveying (V. I). Standard Book House, India.

Shukla, A.K. and K.N. Pandit, 1991. Laboratory manual of farm structure and surveying. IAAS, TU, Nepal.

Sinha, S. N. 1988. Reinforced concrete design (2nd ed.). Tata McGraw Publ., India

3.14 Intedepartmental Courses

3.14.1 Agricultural Statistics

Course Code : AST 221

Course Title : Agricultural Statistics

Credit Hour : 3 (2+1) Full Mark: 75 Theory: 50 Practical: 25

Objectives

Upon the completion of this course, the students will be able to use different statistical tools in designing experiments, analyzing data and drawing inferences and use the knowledge in real life.

Syllabus

An overview of statistics; sampling methods; frequency distributions; presentation of data; measures of central tendency; measures of dispersion; theory of probability and probability distributions; correlation and regression; test of significance Z-test, t-test, x^2 test; and F-test.

Outline

Theory

S.N.	Topic	No. of lecture
1.	Introduction to statistics: definitions, scope and limitations	1
2.	Definition of a population, sample, characteristics of a good sample	1
3.	Measures of central tendency: mean, median, mode	1
4.	Measures of dispersion: range, deviation, quartiles, percentiles, CV%,	1
5.	Moment, skewness and Kurtosis	1
6.	Frequency distribution- presentation, summarization of data; bar and pie graph, histogram, frequency polygon etc.	1
7.	Probability theories	1
6.	Probability distributions: Normal, binomial, poisson	1
8.	Correlation and regression analysis	1

9.	Scatter plots and regression lines	1
10.	Statistical error	1
11.	Statistical hypotheses and test of hopothesis	1
12.	Parametric and non-parametric hypotheses	1
13.	Critical region and level of significance	1
14.	x^2 test as a goodness of fit	1
15.	Test of significance for small samples: t-test	2
16.	Test of significance for large samples: z-test	1
17.	F-test	1
18.	Fundamental and basic principles of experimantal designs	1
19.	Pricision and accuracy	1
20.	ANOVA: introduction, assumptions, principles and limitations	2
21.	Simple designs: CRD and RCBD	2
22.	Latin Square Design and Split-plot Design	1
23.	Factorial concept: Simple effect, Main effect and Interaction effect	2
24.	Factorial experiments without confounding, Yates method	2
25.	Missing plot technique: Barlett's technique for missing plots	1
		30

Practical

S.N.	Topic	No. of practical
1.	Analyzing data in CRD design	1
2.	Analyzing data in RCBD design	1
3.	Analyzing data in Latin Square Design	1
4.	Introducing of data analysis software packages in agriculture	1
5.	Frequency table and histogram in computer	1
6.	Determination of central tendency in computer	1
7.	Determination of measures of dispersion in computer	1
8.	Correlation and Regression analysis using computer	1
9.	Statistical computation and interpretation : z-test and t-test	1
10.	Statistical computation and interpretation: Chi-square test	1
11.	Statistical computation: CRD	1
12.	Statistical computation: RCBD	1
13.	Statistical computation: LSD	1
14.	Statistical computation and interpretation: 2^2	1
15.	Statistical computation and interpretation: 2^3 factorial experiment	1
	Total	**15**

References

Agrawal, B.L. 1996. Basic statistics (3rd ed.), New Age International Pvt. Ltd. New Delhi.

Chandel, S.R.S. 1984. A hand book of agricultural statistics. Achal Prakashan Mandir, India.

Dhakal, C.P. 2013. Elementary statistics in agriculture and environmental sciences. Sajha Prakashan, Lalitpur, Nepal.

Dhakal, C.P. 2015. A handy practical kit of spss for data analysis. Navodit Media Pvt. Ltd. Kathmandu, Nepal.

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for agricultural research. John Willley and Sons, USA.

Gupta S.C. and V.K. Kapoor. 1998. Fundamentals of applied statistics. S. Chand & Co., India.

Rangaswomy, R. 2018. A textbook of agricultural statistics. Newage Int'l Publishers, India.

Tripathi, P.N. 1991. A manual on introductory agricultural statistics. IAAS, TU, Nepal.

3.14.2. Enterprise Learning

Course Code: **ELP 221**

Course Title: **Agriculture Enterprise Learning Program-I**

Credit Hours: 1(0+1) **Full Marks: 25** **Theory: 0** **Practical: 25**

Course Code: **ELP 311**

Course Title: **Agriculture Enterprise Learning Program-II**

Credit Hours: 1(0+1) **Full Marks: 25** **Theory: 0** **Practical: 25**

Course Code: **ELP 321**

Course Title: **Agriculture Enterprise Learning Program-III**

Credit Hours: 1(0+1) **Full Marks: 25** **Theory: 0** **Practical: 25**

Objectives

The student will learn basic skills and develop confidence in agriculture enterprises with focus on three major disciplines (Livestock, Agronomy and Horticulture) but not limited to crop or livestock production only. The enterprise learning program stretches from feasibility study to marketing of any major disciplinary commodity. Thus, it can be treated as an interdepartmental course involving faculties from various departments.

Syllabus

This course will be offered in three semesters – one credit hour assigned to each major enterprise in three semesters on rotational basis. The students will be divided into three groups and each group will be given an opportunity to learn all three disciplinary enterprises. In order to execute the syllabus, the student will prepare protocol under the guidance of assigned faculty, undertake research and produce a report independently in their own language and present to the course in-charge and external examiner in their final practical examination. Course in-charge will encourage students for active participation to learn the enterprises.

3.14.3 Fundamentals of Research, Practices and Seminar

Course Code: **RPS 421**

Course Title: **Fundamentals of Research, Practices and Seminar**

Credit Hour: **4(1+3) Full Marks: 100 Theory: 25 Practical: 75**

Objectives

Upon the completion of this course, the students will be able to learn production and marketing methodologies, data analysis, present a result seminar and document scientific report as a mini-thesis.

Syllabus

This section covers the syllabus of the theory part of RPS course. Concept of research methodology - introduction and types; data types; sampling technique - introduction, types and methods; hypothesis testing - (z-tests, t-tests, chi-square test and f-test); use of correlation, regression and ANOVA with data set. Experimental design - one factor experiment by using Completely Randomized Design or Randomized Complete Block Design; introduction to ANOVA, mean separation and interpretation of results with sample data. Data collection- methods and tools; data management and analysis. Report writing- abstract, introduction, literature review, materials and methods, results and discussion, conclusion and recommendation; references.

Execution modality

The RPS will be offered to undergraduate students both in constituent and affiliated campuses during the final semester of B.Sc Ag. program. The course can be run either on-campus or off-campus mode. The department/campus will assign a faculty to serve as a mentor for individual students. The mentors will be remunerated on per student basis as per the decision of IAAS implementation committee for advisory. In order to facilitate the execution of this course and based on availability, the campus is liable to provide non-consumable items to the students.

Milestones and assessment modality

Milestones heading	Credit hours	Mode of assessment
1. Fundamental of research methods	1+0	Board examination
2. Development of a research proposal	0+1	Internal and External
3. Research in practice	0+1	Internal and External
4. Result seminar, final report, and abstract	0+1	Internal and External
Total	1+3	Internal/external

I. Course Outline for Fundamental of Research Methods (1+0)

S.N.	Topics	No of Lecture
1	Concept, meaning, characteristics and types of research methods	1
2	Literature review : concept and format	1
3	Research proposal development	1
4	Sampling technique – introduction, types, sample size	1
5	Research design : introduction & types of one factor experiment	2
6	Hypothesis testing : z-tests, t-tests, chi-square test and f-test	2
7	Analysis of variance (ANOVA) for CRD and RCBD experiments	1
8	Use of correlation and regression	1
9	Data collection- questionnaire, experimental unit and observable unit and coordination schema.	1
10	Data management and analysis: ANOVA, mean separation and results interpretation	1
11	Result seminar – effective power point presentation	1
12	Preparation of report : formats, abstract, main body, summary, conclusion, and references	2

II. Outline for research proposal development (0+1)

The campus/departments will call for completing proposal submission in the first month of the semester. A time period of three months is allocated to field/survey. Total word counts from Introduction to References should not exceed 1000 words. The proposal should be developed in the following order.

Introduction (problem, review of literature, rationale, broad and specific objectives)
Materials and method(s)

Observations/variables
Expected outputs
Gantt chart
Financial summary

References

III. Research in practice (0+1)

After approval of the project proposal by the respective mentor/department, research can be done independently or liaising with government offices/farmer field/nongovernment organizations. Mentor can allow student up to three months for field/survey activities. Campus is only responsible for the management of providing the facilities available within the limit of campus. Mentor can assist to seek the fund for the student's project.

IV. Research seminar, final report and abstract for publication (0+1)

A final report should be written in English. It should be typed and printed in one side of the A4 size paper not exceeding 35 pages including Introduction to Reference sections of the report. Students are required to produce three hard copies (one for author, one for examination and one for library) of spiral bound report and one CD/DVD for respective campus library. The cover of spiral bound should be light green. Abstract should be submitted two weeks before the scheduled date of presentation by the Board of Examination. The abstract will be published in a campus level symposium proceeding. A brief guideline is given in appendices (A-D).

4. Appendices

Appendix A. General guidelines for the report

Guidelines for report preparation

Left, Right, Top and Bottom margin	: 3.5, 2, 3 and 2.5 cm, respectively.
Spacing	: double (may vary in tables)
Font size and type	: 12 Times New Roman
Number of lines	: ~25 lines
Font style and color	: regular and black
Breaking a word on 2 lines	: not allowed
Printing quality	: laser or letter quality
Page numbers	: bottom center of the page
Justification	: align text to both right and left margins

Guidelines for table, figure, illustration and photograph

Table, figure, illustration and photograph should be within thesis text at appropriate places. These should not be bounded with text. Caption of table should be on the top of the table while the caption for figures, illustration and photographs should be on the bottom.

Order of the pages

Cover page outside (green color A4 paper as in appendix B)
Cover page inside (Appendix C)
Certificate (Appendix D)
Acknowledgements
Table of content
List of figures, illustrations and photographs
List of tables
Acronyms/abbreviations/symbols
Abstract
Introduction to conclusion and recommendations
References (Latest APA style)

Guidelines for presentation

Students should prepare 7-10 slides of their research work and present in 10 minutes during the symposium. In the college level symposium, students not appearing or failing to present are subjected to readmission in the subsequent semester.

Guidelines for abstract preparation

An abstract with at most three authors will be published in a college level proceeding. Abstract writing should not exceed 250 words. It should be written both in Nepali and English. It should be concise, clear and stand alone without any cited references, and briefly highlight the rationale, objectives, materials and methods, results and conclusion in a manner so that it is suitable for direct reproduction in abstracting journals. Abstract is preferred in single spaced regular fonts while the Keywords (≤ 5 words) written in alphabetical order should appear below the abstract in *Italics*.

Abstract

Student Name: Department:

Supervisor name: Campus:

……text**……..**

Keywords: ……..

Appendix B. (Cover page outside)

TITLE OF YOUR RESEARCH

NAME

FEBRUARY, 2020

Appendix C. (Cover page inside)

TITLE OF YOUR RESEARCH

NAME

UNDERGRADUATE THESIS

SUBMITTED TO THE TRIBHUVAN UNIVERSITY

INSTITUTE OF AGRICULTURE AND ANIMAL SCIENCE

NAME OF THE CAMPUS

IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF SCIENCE IN AGRICULTURE

FEBRUARY, 2020

Appendix D. (Final report acceptance form)

CERTIFICATE

This thesis attached hereto, entitled "…**TITLE OF THE THESIS**…" prepared and submitted by (**FULL NAME OF THE AUTHOR**), in partial fulfillment of the requirements for the course of **FUNDAMENTALS OF RESEARCH, PRACTICES AND SEMINAR (RPS 421**) of the Bachelor of Science in Agriculture degree, is hereby accepted. This thesis is a record of original research carried out by Mr/Ms/Mrs.…**NAME OF THE AUTHOR**…and no part of the thesis has been submitted for any other degree or diploma.

……	…….	……
Signature	Signature	Signature
Name of the author	Name of the member advisor	Name of the advisor
Author	Member advisor	Advisor
Date: ……	Date:…….	Date:……

Accepted as partial fulfillment of the requirements for the degree of Bachelor of Science in Agriculture (B.Sc.Ag.).

……

Name

External examiner

Date:. ……

……..

Name

Campus Chief

Date:……..