Programme Code: GECO 81

Programme Name: Ph.D. Agricultural Economics

Programme Outcomes

PO1: This programme will enhance the employability of students in niche emerging areas like data analysis, data management etc.,

PO2: This programme will bolster the graduate's confidence and skill to take up independent research and prepare and evaluate projects which will facilitate their employability by NGOs to carry out survey, data analysis, interpretation and policy formulation.

PO3: This programme will kindle the student's aptitude for novel and futuristic research thus they will imbibe the passion for pursuing independent research and post doctoralprogrammewherebytheir prospects for recruitment as teaching (Assistant Professors) will become bright.

COMMON REGULATIONS TO ALL PH.D. DEGREE PROGRAMMES OF

FACULTY OF AGRICULTURE

(FULL-TIME / PART-TIME / EXTERNAL)

(2019-2020)

REGULATIONS

1. SYSTEM OF EDUCATION

1.1 These rules and regulations shall govern the Ph.D. Programmes leading to the award of Degree of Doctor of Philosophy in the concerned subject in the Faculty of Agriculture, Annamalai University. They shall come into force with effect from the academic year 2019-2020.

1.2 The semester system shall be followed for all the Ph.D. degree programmes.

1.3 The duration of doctoral programmes is as follows:

Programme	Minimum Years	Maximum Years
Full Time	3	5
Part Time / External	4	6

2. DEFINITIONS

2.1 An "Academic year" shall consists of two semesters.

2.2 "Semester" means an academic term consisting of 105 instructional days excluding final theory examinations.

2.3 "Course" means a unit of instruction to be covered in a semester having specific No., title and credits.

2.4 "Credit hour" means, one hour lecture plus two hours of library or home work or two and half hours of library/field practicals per week in a semester.

2.5 'Credit load' of a student during a semester is the total number of credits registered by that student during that particular semester.

2.6 'Grade Point' of a course means the value obtained by dividing the percentage of marks earned in a course by 10 and the Grade Point is expressed on a 10 point scale and rounded off to two decimal places.

2.7 'Credit Point' means the grade point multiplied by corresponding credit hours.

2.8 'Grade Point Average'(GPA) means the quotient of the total credit points obtained by a student in various courses at the end of each semester, divided by the total credit hours taken by the student in that semester. The grading is done on a 10 scale and the GPA has to be corrected to two decimals.

2.9 'Overall Grade Point Average' (OGPA) means the quotient of cumulative credit points obtained by a student in all the courses taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he / she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

3. PROGRAMMES OFFERED

The details of various Ph.D. programmes offered in the Faculty of Agriculture are as follows:

Agrl. Business Management
Agrl. Economics
Agrl. Entomology
Agrl. Extension
Agrl. Microbiology
Agrl. Biotechnology

Agronomy
Genetics and Plant Breeding
Horticulture
Plant Pathology
Seed Science & Technology
Soil Science and Agrl. Chemistry

4. ELIGIBILITY FOR ADMISSION

Candidates seeking admission to Ph.D. programme should satisfy the following requirements.

4.1 Candidates with two year master's degree programmes from Universities recognized by Annamalai University are eligible to apply for Ph.D. programmes of the university (Table 1).

4.2 Candidates who have undergone the programme under conventional system should possess not less than a second class Master's degree. The candidates under trimester system should possess a minimum OGPA of 3.00 out of 4.00. For those under semester system 7.00 out of 10.00 is required for various Doctoral programmes. However, this will not apply to SC/ ST candidates, nominees of State Government / Annamalai University / ICAR / and Government of India for whom a pass in the concerned degree is sufficient.

Table – 1: Eligibility Criteria

Doctoral Degree Programmes	Eligibility
1. Agrl. Business Management	MBA in Agribusiness
2. Agrl. Economics	M.Sc.(Ag.) in Agrl. Economics/ Agrl. Marketing Management.
3. Agrl. Entomology	M.Sc.(Ag.) in Entomology
4. Agrl. Extension	M.Sc.(Ag.) in Agrl. Extension
5. Agrl. Microbiology	M.Sc.(Ag.) in Agrl. Microbiology
6. Agrl. Biotechnology	M.Sc.(Ag.) in Genetics and Plant Breeding / Agrl. Biotechnology
7. Agronomy	M.Sc.(Ag.) in Agronomy
8. Genetics and Plant Breeding	M.Sc.(Ag.) in Genetics and Plant Breeding
9. Horticulture	M.Sc (Ag.) Hort. / M.Sc. (Hort.) /M.Sc. (Hort.) in Fruit Science / Vegetable Science/Floriculture and Landscape Gardening or Architecture / Plantation, Spices, Medicinal and Aromatic Crops
10. Plant Pathology	M.Sc.(Ag.) in Plant Pathology
11. Seed Science & Technology	M.Sc.(Ag.) in Seed Science & Technology
12. Soil Science and Agrl. Chemistry	M.Sc.(Ag.) in Soil Science and Agrl. Chemistry

4.3 Full time programme:

All full time research scholars shall undergo course work for two semesters as prescribed by the Department. Duration of the programe will be for three years.

4.4 Part Time Programme

The part time programme will be offered to the in-service candidates / Research Scholars of projects of Annamalai University. The candidates of this University should route their application through HOD and Dean, Faculty of Agriculture. The duration of the programme will be of 4 years. The in-service candidates / Research Scholars of projects of Annamalai University will be permitted to register the Ph.D. programme by course work and they have to undergo one year course work by utilizing any eligible leave for that period.

4.5. External Registration

The duration of the programme will be of 4 years. The following are the additional conditions for registration for a Ph.D. programme under external category

1. The candidates must register under a research supervisor who is a member of the Teaching Faculty of this University
2. The candidate should be working as Asst. Professor/Associate Professor/Professor or in equivalent positions on permanent basis in a recognized college where facilities for carrying out research work are available and have post graduate departments for Agrl. subjects or working as research assistants in private or government institutions having research and development facilities and who fulfill the eligibility conditions.
3. The candidate should have a recognized co-supervisor in parent department of the organization. The co- supervisor may be from other colleges / organization located from the same place if such persons are not available in the parental organizations.
4. The candidate shall undergo the course of the required credits during I year of the programme in Annamalai University Campus. He / She shall carryout the research at his / her parental organization for the entire of period of the programme.
5. NOC (No Objection Certificate) is to be produced from the employer of the institution / Organization where he / she is working and attached along with the application ii. Co-supervisor acceptance letter should be also be enclosed with the application form.

5. SELECTION PROCEDURE

A candidate who wishes to undertake Ph.D. programme of this University either full time or part time or external registration should apply in the prescribed form on or before the due date.

Applications which fulfil the above conditions (mentioned in the Prospectus) will be scrutinized by a Departmental Research Committee consisting of the Head of the Department (Coordinator), two Professors, one senior Associate Professor and one senior Assistant Professor (not more than five). Eligible candidates will have to appear for entrance test and interview on the dates specified by the University. The selection of the candidates shall be based on marks obtained in the qualifying degree, a written test and an interview. The weightage for Qualifying Degree Examination will be given for 50 marks. The written test shall comprise objective type questions and examine research aptitude, grasp of the subject, intellectual ability and general knowledge of the prospective candidates. The question paper for the written test shall be prepared for one hour duration. Question papers will be set and evaluated by the DRC for 25 marks. The interview will be conducted for 25 marks. The cut off marks for the selection shall be fixed as 50 percent. NET qualified candidates are exempted from the entrance test, but they have to appear for the interview. The minutes of the DRC together with the recommendation will be placed before the Vice-Chancellor who in consultation with the Dean of the Faculty and Head of the Department will select and admit the applicant to work under the guide proposed.

6. CREDIT GRADE POINT REQUIREMENTS

6.1. A student enrolled for Doctoral program to become eligible for the degree is required to complete 75 credits inclusive of 45 credits of research as detailed below

Sl.No.	Details	Credit Hours
1.	Major-Courses	15
2.	Minor-Courses	8
3.	Supporting-Courses	5
4.	Seminar	2
5.	Research	45

	Total	75

6.2. In a semester, a full time Ph.D. student can register a maximum of 15 credits excluding research. However, the research credits registered should not exceed 12 per semester. Semester wise distribution of credits are given in the respective Ph.D., programmes. The total research credits for PT and EXT candidates should be distributed in all the eight semesters. The Ph.D. students (FT/PT/EXT) should complete their course work within two semesters in the first year in Annamalai University campus.

6.3. Requirements for Ph.D. programme shall also include successful completion of thesis research in the major field of study and submission of thesis thereon.

7. ATTENDANCE REQUIREMENT

7.1. "One hundred percent attendance is expected from each scholar. A student who fails to secure 80 per cent of attendance in each subject separately for theory and practical, shall not be permitted to appear for the final examination in that subject and shall be awarded 'E' (incomplete) and will be required to repeat the subject when ever offered.

7.2. In respect of the student who has absented himself / herself for classes with or without valid reasons, that period will be treated as absence only and not as leave. Also, no attendance will be given for writing make up tests.

7.3 In case of new admission, for calculating 80 percent attendance in the first semester, the number of working days will be calculated from the date of joining of the students who are permitted to join late due to administrative reasons. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice - chancellor on the recommendation of the Advisory committee, HOD and Dean, Faculty of Agriculture on payment of condonation fee prescribed by the university.

7.4 Students absenting from the classes with prior permission of the HOD on official University business shall be given due consideration in computing attendance.

7.5. In respect of students who had absented for the mid-semester examination on University business with prior permission of the HOD and Dean, Faculty of Agriculture, the make up mid-semester examination should be conducted ordinarily within 15 working days from the date of conduct of the mid-semester examination.

7.6. The students who absent himself/herself for mid-semester examination in a subject on genuine reasons shall be permitted on the recommendation of the course teacher / Research Supervisor and Head of the Department concerned. Missing examination should be completed within 15 working days from the date of respective examination on payment of missing examination fee prescribed by the university.

7.7 An employee of the University admitted to the programme leading to the Ph.D. Degree as a part-time internal candidate in accordance with these ordinances shall be required to work for a minimum period of 30 days per annum during the period of research. They shall carry out research work without affecting their regular duty.

7.8 External scholars are required to mark attendance maintained by the research supervisor/co-supervisor for a minimum compulsory period of 30 days per annum during their period of research.

7.9 External scholars are required to visit Annamalai University campus at the end of every year on a specified date to appear before the Research Advisory Committee (RAC) for review of the progress of their research work.

7.10 The attendance certificate signed by the research supervisor/co-Supervisor shall be sent to the Director, CARE through the respective Head of the Department and the Dean at the time of submission of the Synopsis.

8. RESEARCH ADVISORY COMMITTEE (RAC)

8.1. Each Ph.D. scholar shall have an RAC to guide the student in carrying out his/her programme. A Research Advisory Committee shall be constituted with the approval of the University for each candidate (full-time, part-time and external) separately, immediately after his/her admission. The purpose of the RAC is to provide expert opinion on frontline research. The Research Advisory Committee shall consist of the Head of the Department or a Professor nominated by the Vice-Chancellor as the Chairperson, the Research Supervisor as the Convener, and two members who are experts in the field nominated by the Vice-Chancellor (one member from the same Department, and the other member from another related Department of our University/another University in Tamil Nadu/other states. The research supervisor in consultation with the HOD will propose the other three members.

8.1.1. Research Supervisor

Every student shall have a research supervisor (among the recognized guides), who will be appointed by the Vice-Chancellor on the recommendation of the Head of the Department and the Dean, Faculty of Agriculture. Research supervisors approved by the Vice-Chancellor only can be the guide for the students. A teacher having Ph.D with 5 years service and PG teaching is eligible for teaching and guiding Ph.D programme. A teacher should have a minimum of three years of service before retirement for allotment of doctoral candidates. The research supervisors who wish to avail leave/lien/deputation beyond a period of six months shall propose a Co-supervisor in the concerned subject for the candidates registered with them and it may be intimated to the University well in advance. The final approval of the proposal rests with the Vice-Chancellor. For external candidate, a Co-supervisor from his/her parental organization will be the Co-Chairman of the Advisory Committee.

8.1.2. Functions of the RAC

The Research Advisory Committee shall have the following functions:

1. Discuss, advice and recommend on all matters connected with the candidate's research from admission till the submission of the thesis.
2. Approve the topic of research and the synopsis.
3. Assess and approve the progress reports of Ph.D. students in the prescribed format and to report to the University on the fitness or otherwise of the candidate to proceed with his/her research work for the Ph.D.
4. If necessary, recommend and approve change of title of dissertation/Thesis, change of research supervisor and status of Researcher (full time to part time and vice-versa)
5. Conduct and supervise the presentation by the candidate of the final draft of his/her proposed thesis for approval before the submission of synopsis of the thesis to the University and to give a certificate to this effect to be submitted along with the synopsis.

8.1.3. The Research Advisory Committee will meet once in six months:

- to scrutinize the research proposal / progress report submitted by the candidate
- to assess the conduct of experiments/field work, peruse laboratory notebooks, data recording, analysis, and publication
- to review and endorse the annual progress report of the candidate.
- to approve the synopsis of the thesis.

The convener will convene the Research Advisory Committee meetings with intimation to the Director, CARE.

8.2. Changes in RAC

The proposals for changes in the RAC is to be sent to the Director, CARE, through HOD and Dean for approval, if it is keenly felt that such changes are absolutely necessary.

8.3. Change of Research Supervisor

8.3.1 Change of research supervisor shall not be permitted as a routine. In exceptional cases, such change may be permitted, if valid reasons are provided by the candidates. The Committee headed by the Vice-Chancellor shall look into the request of the petitioner, if there is any conflict between the scholar and the research supervisor. The research supervisor under whom the scholar has originally registered shall give a "No Objection Certificate" and the new proposed Research Supervisor should give a "Certificate of Willingness" to guide the candidate. The final decision will rest with the University. However, the Vice-Chancellor, on the recommendation of the RAC and Dean's Committee, has the right to assign a new research supervisor to the research scholar.

8.3.2 When the change of Research Supervisor is approved, the candidate shall work for a minimum of one year with the new Research Supervisor if the topic of his/her research is different under the new supervisor, provided he/she fulfils the attendance requirements.

8.4 Change of Topic of Research

8.4.1 Change of the specific area of research may be permitted within one year from the date of admission and request must be submitted with the recommendations of the RAC. In such cases, the minutes of the RAC meeting must include whether the course work undertaken by the candidate is relevant to the new research area and the competence of the research supervisor in this field.

8.4.2 If the RAC is of the view that there is a major change in the specific area of research and is not relevant to the course work undertaken, the candidates will have to go through the process of fresh examination pertaining to the area of research.

8.5. Absence of member during qualifying / final Viva-Voce examination

Under extra-ordinary circumstances if the qualifying/ final viva-voce examination to Ph.D. student has to be conducted in the absence of one or two RAC members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Director, CARE in advance.

9. EVALUATION OF STUDENT'S PERFORMANCE

All students shall abide by the rules for evaluating the course work under the semester system of education, as prescribed from time to time by the university.

9.1. Examinations

There will be two examinations viz. mid semester and final examination. Wherever the course has practical, there will be a final practical examination also.

9.2. Grading

- The duration of mid semester examination will be of one hour and final examinations in theory and practical will be conducted for three hours each.
- The mid semester examinations will be conducted by course teachers during the ninth week of the semester as per the scheme drawn by HOD, evaluate and send the marks obtained by the students to the Director, CARE through HOD within seven working days.
- There will be final examination separately for theory and practical which will be conducted by the University. Each final theory and practical examinations will be evaluated by two examiners (one will be the course teacher and another will be the senior faculty of the Department).

- The distribution of marks will be as indicated below:

S.No	Examination	Course with practical	Course without practical	Course without theory
1	Mid-semester	30	30	30
2	Final theory	40	70	-
3	Final practical	30	-	70
	Total	**100**	**100**	**100**

The question paper model and distribution of marks for mid semester and final theory examinations are as follows.

Mid semester :

1	Objective Type	10 out of 12	(10 x 0.5)	5 marks
2	Definitions/concepts	5 out of 7	(5 x 1)	5 marks
3.	Short notes	5 out of 7	(5 x 2)	10 marks
4	Essay type	2 out of 3	(2x5)	10 marks

Final Theory:

Courses without practical (70 marks)

1.	Short notes	5 out of 7	(5 x 4)	20 marks
2	Essay type	5 out of 7	(5 x 10)	50 marks

Courses with practical (40 marks)

1.	Short notes	5 out of 7	(5 x2)	10 marks
2	Essay type	5 out of 7	(5 x 6)	30 marks

9.3. Minimum Marks for Pass

a) The student should secure a minimum of 60 per cent marks separately in the theory and practical and an aggregate of 70 per cent to secure a pass in the subject .

b) Each subject shall carry a maximum of 100 marks for purpose of grading. The grading will be done as grade point. i.e., the percentage of marks earned in a subject is divided by 10. The grade point is expressed on a 10 point scale upto two decimals.

c) Students who secure marks below 70 per cent in a subject will be awarded 'F' grade and students without having the required minimum attendance of 80 per cent will not be allowed to write the final examination and they will be awarded 'E' grade. Students who secure 'F' grade should appear for re-examination in the subsequent semester.

d) If a student secured 'E' grade, he/she has to re-register and attend the course again during the next academic year.

9.4. Minimum GPA Requirement

A Ph.D student to continue his/her studies in the University, should maintain certain minimum Average Grade Point prescribed here under:

a) Earn a Grade Point of 7.00 for a pass in each subject.

b) For purpose of continuing as a student in the university, a candidate is required to earn an Overall Grade Point Average of not less than 7.50 at the end of each semester

c) A Ph.D. student may repeat the course(s) in which he/she gets a Grade point below 7.50 and above 7.0 to improve the OGPA.

9.5. Re-Examination

Re-examination is permitted only for the final theory and practical examinations. The students who secure 'F' grade are permitted to write the re-examinations as and when conducted with the permission of university. The

re-examination fee as prescribed by university per course is to be paid on or before the prescribed date. A student is permitted to write the final theory and practical examinations only two times during the course period of three years excluding the regular final examination. In the event of a student who fails to secure a pass in the two re-examinations permitted, he/she has to re-register for the course along with juniors. The marks secured in mid semester examination will be retained and the student should produce the practical record during re-examination. The registration for the re-examination shall be done after mid-semester examination on the date specified by the Director, CARE. Each registration is considered as an attempt even if the student absents for the examination.

9.6. Return Of Valued Answer Papers

The valued answer papers of mid-semester shall be shown to the students after the examination. Discrepancies if any, in awarding marks, the student can approach the teacher concerned immediately for rectification. The answer paper should be retained with the course teacher for six months and then disposed off. Evaluated final theory papers have to be retained up to six months by the Director, CARE after the conduct of examination and then disposed off.

10. CREDIT SEMINAR

Seminar is compulsory for all students and each student should register and present two seminars each with 0+1 credits. A student can register only one seminar in a semester and only after successful completion of the first seminar the student is permitted to register for the second seminar.

10.1. Credit Seminar Topic

10.1.1 The seminar topic should be only from the major field and should not be related to the area of thesis research.

10.1.2 The seminar topics are to be assigned to the students by the research supervisor in consultation with HOD within three weeks after commencement of the semester.

10.1.3. Under the guidance and supervision of the research supervisor of the RAC, the student should prepare a seminar paper containing not less than 50 typed and printed pages with a minimum number of 75 references covering the recent 10 years time after reviewing all the available literature and present the seminar after completion of 80% attendance in the semester in the presence of the HOD, RAC, staff and post-graduate students of the concerned department.

10.1.4. The circular on the presentation of the seminars may be sent to other Departments to enable those interested to attend the same.

10.1.5. The research supervisor will monitor the progress of the preparation of the seminar and correct the manuscript. The student will submit 2 copies of the corrected manuscript to the HOD through chairman before presentation.

The student will incorporate the suggestions and carry out corrections made during the presentation and resubmit three fair copies to the HOD (one to Dept. library, the second to the research supervisor and the third for student) within 15 days after presentation.

10.1.6. The performance of the student in the credit seminar will be evaluated and grade point awarded by the HOD along with the RAC for 100 marks. Grade Point may be given based on the following norms:

Details	Marks
Coverage of literature	40
Presentation	30
Use of audio visual aids	10

Capacity to participate in discussion and answer the questions	20
Total	100

11. QUALIFYING EXAMINATION

Only those students who successfully complete the qualifying examination will be admitted to candidacy of the degree. The qualifying examination consists of written and oral examination.

11.1. Minimum requirement for Qualifying Examination

The students who have completed all the courses and earned a grade point average of not less than 7.5 will be permitted to appear for the qualifying examination. Students who do not satisfy these requirements shall not be permitted to take up the qualifying examination. The qualifying examination will be conducted after the completion of course work.

11.2. Selection of Examiner

A panel of five external examiners for qualifying examinations shall be given by the RAC in consultation with HOD before three months of the date of completion of the student's course work to the Director, CARE. One of them will be appointed as external examiner.

11.3. Written Examination

The written examination consists of two papers covering major and minor subjects only. The Director, CARE will conduct the examination by obtaining the question paper from Head of Department to be prepared in consultation with the course teachers concerned.

The question paper for the written examination will be of 3 hours duration and each question (Essay type) need not be restricted to any particular topic in a course but it should be a comprehensive covering of each unit of the syllabus of each course. The written examinations will be conducted at the same time in all disciplines. The answer papers will be evaluated by the research supervisor and Head of the Department or a senior faculty nominated by the Head of the Department. Qualifying marks for passing the examination will be 60. The viva-voce will be conducted by the external examiner after the candidates passes the qualify examination.

11.4. Qualifying viva-voce Examination

The RAC shall conduct the qualifying viva-voce examination with one external member who shall be a specialist in the subject from outside the university

11.5. The Heads of Departments will monitor and coordinate the conduct of the qualifying viva. The performance of the candidate will be graded as Satisfactory / Unsatisfactory.

11.6. Communication of Results of Qualifying Examination

The research supervisor shall act as chairman for the examination committee and shall be responsible for communicating the results of the examination to the Controller of Examination through HOD in the prescribed format.

11.7. Failure /Absence in Qualifying Examination

When a student fails or absents for the qualifying examination, he/she may apply again for permission to appear for re-examination to the Controller of Examination with the recommendation of the chairman of the RAC and Head of the Department. A student, who applies for re-examination should attend written examination and viva-voce. Re-examination shall not take place earlier than three months after the first examination and it will be conducted by the advisory committee as previously indicated. If a student fails in the re-examination, further re-examination will be considered on the recommendation of the RAC, HOD and Dean, Faculty of Agriculture.

If the students fail in the qualifying examination, he / she is not permitted to register for further research credits.

12. THESIS RESEARCH

12.1. Selection of Topic

The thesis research for the Ph.D. degree should be of the nature of a definite contribution to the subject and the results should be of sufficient importance to merit publication. The findings should have some practical utility or should lead to theoretical contribution. The thesis shall be on a topic falling within the field of the major specialization and shall be the result of the student's own work. A certificate to this effect duly endorsed by the major advisor shall accompany the thesis.

12.2. Research Proposal

The research scholars shall present their broad area of research and submit a proposal to the Research Advisory Committee at the end of the first semester. The research proposal has to be presented by the student in a meeting organized by the Head of the department to get the opinion / suggestion of the scientists of the department for improving it. Three copies of the research proposal in the prescribed format should be sent to the Director (CARE) through the Head of the Department for approval

The distribution of research credit will be as follows

Semester	Credit Hours
I Semester	0+1
II Semester	0+2
III Semester	0+12
IV Semester	0+12
V Semester	0+9
VI Semester	0+9
Total	0+45

The total research credits for PT and EXT candidates should be distributed in all the eight semesters as advised by RAC.

12.3. Evaluation of Thesis Research

After assigning the research problem, for each semester, the student has to submit a detailed programme of work to be carried out by him/her during the semester in the prescribed proforma. After scrutiny and approval, a copy of the programme has to be given to the student for carrying out the work during the semester.

12.3.1. Attendance register must be maintained in the Department by HOD for all the students to monitor whether the student has 80% of attendance in research.

12.3.2. The student has to submit his/her research observation note book to the research supervisor who will scrutinize the progress and sign the note book with remarks as frequently as possible. This note book will form the basis for evaluation of research progress.

12.3.3. After completion of 80% attendance for research and on or before the last day of the semester, the research Scholars, both full time and part time, shall submit Progress Reports in the prescribed format (Annexure-3) duly endorsed by the Research Advisory Committee to the Director, CARE until they submit their synopsis.

12.3.4 Failure to submit the progress reports shall entail automatic cancellation of registration.

12.3.5 The minutes of the meeting of the Research Advisory Committee along with enclosures will be sent to the Director, CARE.

12.3.6 The review meetings of the RAC may also be conducted through video conferencing or internet chat if the candidate or the Research Supervisor is in a foreign country.

12.3.7 Candidates who are recipients of fellowships such as JRF/SRF directly from any of the funding agencies/ shall send the progress reports and the utilization certificates in the format prescribed by the respective funding agency through proper channel.

12.3.8. The procedure of evaluating research credits under different situations are explained hereunder.

SITUATION – I

The student, has completed the research credits as per the approved programme and awarded SATISFACTORY by the RAC. Under the said situation the student can be permitted to register for fresh research credits in the subsequent semester. If the student is awarded UNSATISFACTORY, he/she has to re-register the same block of research credits in the subsequent semester.

SITUATION – II

The student who has not secured the minimum attendance of 80 percent shall be awarded grade E. The student has to re-register the same block of research credits for which 'E' grade was awarded earlier in the following semester with prior permission. Until the completion of reregistered credits, the student should not be allowed to register for fresh (first time) research credits.

SITUATION – III

The student could not complete the research as per the approved programme of work for reasons beyond his/her control such as,

a) Failure of crop
b) Non-incidence of pests or disease or lack of such necessary experimental conditions.
c) Non-availability of treatment materials like planting materials chemicals, etc.
d) Any other impeding / unfavourable situation for satisfying the advisory committee.

Under the said situations grade EE should be awarded.

In the mark list, it should be mentioned that E grade or EE grade was awarded due to 'lack of attendance' or 'want for favourable experimental conditions'.

SITUATION – IV

When the student failed to complete the work even in the 'second time' registration, the student will be awarded UNSATISFACTORY and in the mark list the 'second time' should be mentioned.

For the registration of research credits for the third time, permission has to be obtained from the Dean based on the recommendation of the RAC, and HOD. Permission for registration for the fourth time shall be given only by University based on the recommendation of the RAC, HOD and Dean, Faculty of Agriculture.

13. SUBMISSION OF THESIS

The research credits registered in the last semester should be evaluated only at the time of the submission of thesis, by the RAC. Students can submit the thesis at the end of the final semester. If a student has completed the thesis before the closure of the final semester, the research supervisor can convene the RAC meeting and take decision on the submission of the thesis, provided the student satisfies 80 per cent attendance requirement. The candidate shall be allowed to submit his/her thesis after the completion of stipulated period. A grace period of 30 days may be allowed to submit the thesis after the prescribed duration. If the

thesis is not submitted even after the grace period, the student shall pay the tuition fee for the year.

If a student is not able to submit the thesis within the grace period, the student has to re-register for the credits in the forthcoming semester. The student who re-registers the credits after availing of the grace period will not be permitted to avail of grace period for the second time. The Head of the Departments can sanction the grace period based on the recommendation of advisory committee and a copy of the permission letter along with the receipt for payment of fine should accompany the thesis while submission

Five copies of the thesis (in the approved format) shall be submitted together with the submission fee not later than three months after the submission of the synopsis. No dues certificates from the Department and Central Libraries, Hostel, Stores, etc. must be submitted with the thesis copies. The Research Supervisor shall forward the thesis copies with the enclosures to the Director, CARE through the HOD and the Dean. A soft copy of the thesis in PDF fromat as prescribed by Shodhganga, shall also be submitted.

The Ph.D scholars have to publish a minimum of two research papers in Scopus / Web of Science indexed journal. The synopsis will be accepted for processing only after showing evidences for publications of 2 such articles.

The soft copy of the thesis shall be checked for plagiarism using Turnitin software. Beyond the percentage of reproduction prescribed by UGC will not be accepted for avaluation.

13.1 Pre-submission Presentation

1. The pre-submission presentation of the thesis is a requirement to enrich the scholar and to fine tune his/her research presentation
2. This presentation shall be conducted before the submission of the synopsis in the presence of the RAC, Supervisor/Co-Supervisor, Faculty members, Research Scholars, M.Phil., and /or P.G. Students.
3. The scholar is expected to present the first draft of the research work or explain the findings/problems faced.
4. The gathering may suggest ideas/references to be consulted/suggestions to improve the work and so on.
5. A report on this event along with an attendance sheet shall be forwarded by the Research Supervisor with the endorsement of the RAC and HOD to the Director, CARE.

13.2 Submission of Synopsis

1. The submission of synopsis may be permitted 3 months before the completion of required duration on successful completion of course work
2. The Research Scholar shall submit 3 copies of the synopsis approved by the Research Advisory Committee along with a soft copy to the Director, CARE through the Research Supervisor, the HOD and Dean of the respective Faculty. Guidelines for the preparation of the synopsis are appended in Annexure -4
3. Name of the candidate and name of the supervisor shall not be mentioned anywhere in the synopsis; enrolment number of the candidate alone shall be given. A model cover page for a synopsis is given in Annexure – 5

13.3 Guidelines for Preparation of Thesis

1. The thesis shall not exceed 250 pages excluding the Bibilography, Appendices, etc. If it exceeds the specified number of pages, the Research Supervisor should write to University with the reasons and get prior approval from the University. The candidate shall pay a penalty for the excess number of pages as decided by the Deans Committee. The thesis should be in A4 size. The specification for the

preparation of the thesis are given in Annexure-7. A model cover page for a thesis is given in Annexure -8.

2. The thesis shall be typed on both sides of the page in order to save paper and postage

3. The thesis shall contain a Certificate from the guide (Annexure-9) specifying that the thesis submitted is a record of research work done by the candidate during the period of study under him/her and that the thesis has not previously formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or similar title. A statement from the guide indicating the extent to which the thesis represents independent work on the part of the candidate should also be made.

4. The thesis shall also contain a Declaration by the candidate (Annexure -10) that

the work reported in the thesis has been carried out by the candidate himself/herself and that the material from other sources, if any, is duly acknowledged and no part of the thesis is plagiarized.

14. VALUATION OF THE THESIS Panel Of Examiners

The thesis submitted in partial fulfillment of the Ph.D. degree shall be evaluated by two external experts one from within the country and the other from outside the country appointed by the Vice-Chancellor on the recommendation of the research supervisor of the RAC, HOD and Dean. They shall be chosen from a panel of at least five names of specialists separately from within the country and outside the country in the particular field, suggested by the research supervisor. The external experts shall send their evaluation reports of the thesis directly to the Director, CARE along with the copy of the evaluated thesis. The Director, CARE on receipt of the reports from the two examiners will send them to the concerned guide who is the convener of viva-voce board. The guide will send the consolidated report with his remarks to the Director, CARE through the Head of the Department. On the satisfactory reports of the evaluation, viva-voce examination will be arranged.

After a student's thesis for Ph.D. degree is evaluated as indicated above, the thesis shall be finally accepted for the award only after the student satisfactorily completes a final viva-voce examination. The Viva-Voce board comprises the student's RAC with the addition of the external examiner who valued the thesis, and the HOD. If the HOD happens to be the research supervisor, the Dean, Faculty of Agriculture will nominate a senior member of the staff of the concerned Department as a member. In case of external candidates, the co-supervisor will also serve as a member of the viva-voce board. The candidate is expected to defend the thesis at the viva-voce examination. The degree shall be awarded on the unanimous recommendation of the examining committee as satisfactory with regard to the thesis and the performance of the student in the final oral examination. The recommendation of the committee shall be forwarded to the Director, CARE by the research supervisor through HOD and Dean which shall be signed by all members of the committee and the external examiner. A candidate who is not successful (unsatisfactory) at the viva –voce examination will be permitted to undergo the viva voce examination again within a period of three months.

14.2. Revision and Resubmission of Thesis

i. If an examiner recommends change / further work, the thesis will be referred to the same examiner after compliance for his opinion. In case of rejection by any one of the examiners, the thesis will be sent to another examiner and his / her recommendation will be final.

ii. If the thesis is recommended to be revised by one or both examiners, the points of revision will be indicated clearly in the report. The necessary correction should be carried out, and the revised version should be sent to the concerned

examiner(s). If the examiner(s) is / are still not satisfied with the revised version, the thesis will be rejected. If the thesis is accepted by the examiners (Evaluation), Viva–Voce examination will be conducted by the viva-voce board.

14.3. Re-registration and Submission of Thesis

The minimum of 80% attendance requirement for submitting the thesis after re-registration need not be insisted for those students who have fulfilled the minimum academic and residential requirement of 3 or 4 years.

14.4. Extension of Time

1. Research scholars who do not submit the thesis within the stipulated period as per full-time/part-time/external mode should apply for extension of time three months before the completion of 3 or 4 years. Extension of time and the fees to be paid will be considered by the Deans Committee, if the extension is duly recommended by the RAC, Head of the Department, and the Dean of the Faculty, such candidates will be eligible for extension of time for a maximum period of two years.
2. The scholar will have to enroll as fresh candidates if he/she fails to submit the thesis within the maximum extension period of three years when granted.
3. If a scholar requires a few more months after the expiry of the maximum extension period of two years for the submission of the thesis as per the evaluation of the RAC, duly recommended by the Head of the Department and the Dean of the Faculty, as an exceptional case, the Deans committee may consider for re-registration to enable the scholar to submit the thesis. In any case, the time granted shall not exceed six/ twelve months.

14.5. Number of Chances

A candidate will not be permitted to submit a thesis for the degree on more than two occasions. However, it will be open to the syndicate, if the Board of Examiners so recommend, to permit the candidate to submit a thesis on a third occasion. Also, he/she will not be permitted to appear for the viva-voce examination on more than two occasions.

15. DISCONTINUANCE AND READMISSION

15.1. Students admitted to the PhD degree who discontinue their studies before completing the degree with written permission from the University may be re-admitted to the degree programme, provided that the student should have completed the course work before such discontinuance. However the period of such discontinuance should not exceed five years for Ph.D. Degree from date of admission.

15.2. After completion of course work and qualifying examination, a student is eligible to discontinue temporarily his research program only once within 5 years for PhD program. If the discontinuation period exceeds two semesters, the student has to forego the research credits already registered and register afresh with revised program. In the case of field experiments or laboratory experiments in which continuity is essential for research and if a student temporarily discontinues in the middle without completing the experiments, then the entire experiment should be repeated even if the discontinuation period does not exceed two semesters.

15.3. A student joining the studies, after discontinuation should pay the fees of the existing semester.

16. PUBLICATION OF THE THESIS

The thesis, whether approved or not, should not be published in full or abridged form without the permission of the Syndicate, which may grant permission for the publication under such conditions as it may impose.

17. Each Department should maintain a list of theses produced so far with the abstract of the same.

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Department of Agricultural Economics

Ph.D. Agricultural Economics (by course work)
Full Time/Part time/External
2019-20

Major Courses

AEC 811	Advanced Micro Economic Analysis	2+1
AEC 812	Advanced Macro Economic Analysis	3+0
AEC 813	Advanced Production Economics	2+1
AEC 814	Advanced Agricultural Marketing and Price Analysis	2+1
AEC 821	Applied Econometrics	2+1
AEC 822	Agricultural Development and Policy Analysis	3+0
AEC 823	Environmental Economics	2+1
AEC 824	Agricultural Finance and Project Management	2+1

Minor Courses

AEC 815	Natural Resource Management	2+1
AEC 825	International Trade and Intellectual Property Management	2+1
AEC 826	MOOC	2+0

Supportive Courses

COM 811	Advances in Computer Applications	0+1
LIS 812	Advances in Agricultural Information Retrieval	0+1
STA 821	Advanced Statistical Methods for Social Science	2+1
	Seminar	0+2
	Research	0+45

Ph.D. in Agricultural Economics (Revised Syllabus 2019-20 onwards)

Semester Wise Distribution of Courses

Semester I

Major Courses*

AEC 811	Advanced Micro Economic Analysis	2+1
AEC 812	Advanced Macro Economic Analysis	3+0
AEC 813	Advanced Production Economics	2+1
AEC 814	Advanced Agricultural Marketing and Price Analysis	2+1

Minor Courses (for other department/discipline)

AEC 815	Natural Resource Management (for other department/discipline)	2+1

Supportive Courses

COM 811	Advances in Computer Applications	0+1
LIS 812	Advances in Agricultural Information Retrieval	0+1
AEC 801	Seminar	0+1
AEC 081	Research	0+1
	Sub Total	**16 credits**

Semester II

Major Courses **

AEC 821	Applied Econometrics	2+1
AEC 822	Agricultural Development and Policy Analysis	3+0
AEC 823	Environmental Economics	2+1
AEC 824	Agricultural Finance and Project Management	2+1

Minor Courses (for other department/discipline)

AEC 825	International Trade and Intellectual Property Management	2+1
AEC 826	MOOC	2+0

Supportive Courses

STA 821	Advanced Statistical Methods for Social Science	2+1
AEC 802	Seminar	0+2
AEC 082	Research	0+1
	Sub Total	**17 Credits**

Semester III

AEC 083	Research	0+12

Semester IV

AEC 084	Research	0+12

Semester V

AEC 085	Research	0+9

Semester VI

AEC 086	Research	0+9

Grand Total = 75 Credits

*** Any Three** **** Any Two'**

All Minor courses should be from other Departments or discipline.

AEC 811 Advanced Micro Economic Analysis (2+1)

Learning Objectives

- To introduce the theoretical models and applications of microeconomic theory to the students
- To give exposure to price determination under different market situations
- To study about welfare economics including the theory of public choice.

Theory

UNIT I: Theory of consumer behaviour

Introduction – duality in consumer theory – expenditure function and indirect utility function . Measurement of income effect and substitution effect. Measurement of changes in consumers' welfare – consumer's surplus, compensating variation and equivalent variation .

UNIT II: Demand functions

Dynamic versions of demand functions – integrability of demand functions. Demand models – linear expenditure system, Almost ideal demand system. Applications of consumer theory – household model and time allocation – labour supply decisions by households.

UNIT III: Market structure

Perfect competition , imperfect market - monopoly, monopolistic competition and oligopoly. Oligopoly models – collusive and non-collusive models of oligopoly - Cournot model, Chamberlin model, Stackleberg solution. Market equilibrium - impact of tax on equilibrium

UNIT IV: General equilibrium theory

Conceptual overview - general equilibrium conditions with production and consumption. Existence, uniqueness and stability of general competitive equilibrium. Walrasian general equilibrium – mathematical derivation of conditions for general equilibrium.

UNIT V: Welfare economics

Concepts, problems, approaches and limitations of welfare economics, Pareto conditions of maximum welfare – criteria for social welfare - social welfare functions, social versus private costs and benefits. **Current streams of thought**

Practical

Problems in consumer utility maximization – estimation of income and substitution effects; Estimation and comparison of consumer's surplus, equivalent variation and compensating variation. Estimation of demand models –derivation and estimation of labour supply equations from household models comparative static analysis in consumption. Advanced problem solving in price determination under perfect competition, monopoly, oligopoly and monopolistic competition. Price discrimination - game theory models. Problems in General Equilibrium Theory and welfare economics.

Theory lecture schedule

1. Theory of consumer behavior - introduction
2. Duality in consumer theory
3. Expenditure function
4. Indirect utility function
5. Measurement of income effect and substitution effect
6. Measurement of changes in consumers' welfare
7. Consumer's surplus
8. Compensating variation and equivalent variation
9. Demand functions – types and forms
10. Dynamic versions of demand functions
11. Supply functions
12. Demand models – introduction
13. Linear expenditure system
14. Almost ideal demand system
15. Applications of consumer theory
16. Household model and time allocation
17. Labour supply decisions by households
18. **Mid Semester Examination**
19. Market structure , conduct and performance
20. Perfect competition
21. Imperfect market – monopoly
22. Monopolistic competition and oligopoly
23. Oligopoly models – collusive and non-collusive models of oligopoly
24. Cournot model, Chamberlin model and Stackleberg solution
25. Price determination under different market situations
26. Market equilibrium
27. Impact of tax on equilibrium
28. General equilibrium theory - conceptual overview
29. General equilibrium conditions with production and consumption .
30. Existence, uniqueness and stability of general competitive equilibrium
31. Walrasian general equilibrium – mathematical derivation of conditions for general equilibrium
32. Welfare economics - concepts, problems, approaches and

limitations of welfare economics

33. Pareto conditions of maximum welfare – criteria for social welfare
34. Social welfare functions, social versus private costs and benefits.

Practicalschedule

1. Problems in consumer utility maximization
2. Estimation of income and substitution effects
3. Estimation and comparison of consumer's surplus
4. Equivalent variation and compensating variation
5. Estimation of demand models
6. Almost ideal demand system
7. Derivation and estimation of labour supply equations from household models
8. Market equilibrium
9. Comparative static analysis in consumption
10. Price determination under perfect compe tition
11. Price determination under monopoly
12. Price discrimination
13. Price determination under oligopoly
14. Price determination under monopolistic competition
15. Game theory models
16. General equilibrium theory
17. Welfare economics

Course Outcomes

At the end of the course students will be able to

CO1: Identify the way to maximize profit through cost minimisation.

CO2: Know the different market structures and to identify long run and short run equilibrium.

CO3: Apply micro economic principles for the welfare of farming community.

CO – PO Mapping

	PO1	PO2	PO3
CO1	3		3
CO2		3	3
CO3	3	3	

References

1. Ahuja, H.L., (2016), *Principles of Micro Economics,* Sultan Chand, New Delhi.
2. Barthwal, R,R,, (2012), *Microeconomic Analysis,* New Age International (P) Ltd., New Delhi.
3. Chauhan, S.P.S., (2008), *Micro Economics, Theory and Applications*, Prentice Hall India Learning Private Limited, New Delhi.
4. David Besanko and Ronald Braeutigm, (2013), *Micro Economics*, Willey Black Well, New York.
5. David, L. Debertin (2012), *Applied Micro Economics, Consumption, Production and Markets,* Create Space Independent Publisher, New Delhi.
6. Gregory Mankiw, N., (2007), *Principles of Microeconomics*, Cengage Learning India Pvt. Ltd., New Delhi.
7. Hal. R. Varian, (2010), *Intermediate Micro Economics: A Modern Approach*, Springer Publishing Company, New York.
8. Henderson , JM ., and RE.Quandt (2001), *MicroeconomicTheory:AMathematicalApproach* , McGraw -Hill , New York.
9. Koutsoyiannis A. (2003), *Modern Microeconomics* , London The Macmillan Press Ltd. .
10. Sankaran, S., (2012), *Micro Economics*, Margham publications, Chennai.

AEC 812 Advanced Macroeconomic Analysis (3+0)

Learning Objectives

- To impart the knowledge on the macroeconomic theory and macroeconomic policy issues.

Theory

UNIT I: Macro economics- review

Review of macro economics concepts - Keynesian theory - consumption function and theories of consumption – saving function and theories of saving – actual and potential GNP – fluctuations and growth – a review of the national income and product accounts introduction to income determination – the multiplier - national income determination – the static equilibrium model demand – side equilibrium – income and interest rate – consumption and consumption expenditure.

UNIT II: Investment- savings

Theories of investment - savings and investment equality - IS – LM Framework. Demand for and supply of money - monetary policy in the static model –an introduction to fiscal policy –investment demand – monetary and fiscal policy in the extended model – inflation , productivity and income distribution.

UNIT III: Labour market

Stagflation and supply side economics - theories of unemployment - Phillips curve – demand and supply in the labour market supply – side equilibrium – output and the price level equilibrium in the static model – search, wage rigidity and unemployment rational expectations and demand policy – sectoral demand functions and extensions of the static model – macroeconomics when markets do not clear.

UNIT IV: Growth models

National income accounting - recent concepts – green accounting – medium term dynamics – between static equilibrium and long run growth – introduction to stock adjustment dynamics – trend growth in the static model – long run growth with full employment – introduction to growth models – the basic model extended – varying saving assumptions – the golden rule and an introduction to optimal growth models.

UNIT V: Macroeconomic policy

BOP & adjustment policies - foreign exchange policy - foreign sector: capital and current account - impact of WTO on indian economy - impact of IMF & IBRD on Indian economy - review of macro economic policies in India – the foreign sector and balance of payments. **Current streams of thought**

Theory lecture schedule

1. Review of macro economics concepts
2. Keynesian theory - consumption function
3. Theories of consumption
4. Saving function and theories of saving
5. Actual and potential GNP – fluctuations and growth
6. Review of the national income and product accounts
7. Introduction to income determination
8. Multiplier national income determination
9. Static equilibrium model
10. Demand – side equilibrium
11. Income and interest rate
12. Consumption and consumption expenditure
13. Investment – savings, theories of investment
14. Savings and investment equality - IS – LM Framewor k
15. Demand for and supply of money - monetary policy in the static model
16. Introduction to fiscal policy
17. Investment demand – monetary and fiscal policy in the extended model
18. Inflation, productivity and income distribution
19. Labour market
20. Stagflation and supply side economics
21. Theor ies of unemployment - Phillips curve
22. Demand and supply in the labour market
23. Supply – side equilibrium
24. Output and the price level equilibrium in the static model
25. Wage rigidity and unemployment
26. **Mid Semester Examination**
27. Rational expectations and demand policy
28. Sectoral demand functions and extensions of the static model
29. Macro economics when markets do not clear
30. Growth models
31. National income accounting - recent concepts
32. Green accounting – medium term dynamics – between static equilibrium and long run growth
33. Introduction to stock adjustment dynamics
34. Trend growth in the static model

35. Long run growth with full employment
36. Basic growth model
37. Varying saving assumptions
38. Gol den rule and an introduction to optimal growth models
39. Macroeconomics – basic concepts
40. Macroeconomic policy
41. BOP and adjustment policies
42. Foreign exchange market
43. Foreign exchange policy
44. Foreign secto r -capital and current account
45. Objectives and functions of WTO
46. Role of IMF in foreign trade
47. Impact of WTO on Indian economy
48. Impact of IMF on Indian economy
49. Impact of IBRD on Indian economy
50. Review of macro economic policies in India
51. Foreign sector and balance of payments.

Course Outcomes

At the end of the course students will be able to

CO1: Understand the nature of inflation and ways to control it.

CO2: Analyze monetary and fiscal policies.

CO – PO Mapping

	PO1	PO2	PO3
CO1	3		3
CO2		3	3

References

1. Ahuja, H.L., (2016), *Macroeconomics, Theory and Policy*, Sultan Chand and Sons, Pvt. Ltd., New Delhi.
2. Cauvery, R., U.K. Sudhanayak, M. Girija, and R.M. Meenakshi, (2015), *Macro Economics,* Sultan Chand, New Delhi.
3. Chandana Ghosh, Ambar Ghosh, (2011), *Macro Economics,* PH Learning Pvt. Ltd., New Delhi.

4. Frogen , RT. , (1999), *MacroEconomic:TheoryandPolicies* , PrenticeHall , New Delhi.
5. Gupta, G. S., (2017), *Macro Economics Theory and Applications,* McGraw Hill Education, New Delhi.
6. Jhingan, M.L., (2014, *Macro Economics Theory,* Vrinda Publication Pvt. Ltd., New Delhi.
7. Maria John Kennedy, M., (2011), *Macro Economics,* Prentice Hall India Learning Private Limited, New Delhi.
8. RudigerDornbusch, Stanley Fischer and Richard Starz, (2017), *Macro Economics,* McGraw Hill, New Delhi.
9. Samuelson ,PA .,and WD. Nordhaus , (2004),*Economics* , McGraw -Hill , New Delhi.
10. Sankaran, S., (2016), *Macro Economics*, Marghum publication, Chennai

AEC 813 Advanced Production Economics (2+1)

LearningObjectives

- To provide applied and practical understanding of production economics
- To explain farm management techniques with emphasis on its economic analysis

Theory

UNIT I: Productionfunction

Production functions, components, assumptions, properties and their economic interpretation - concepts of homogeneity, APP, MPP, elasticities of substitution and their economic relevance – production relations –optimality - commonly used functional forms, nature, properties, limitations, estimation and interpretation -linear, Spillman, Cobb Douglas, quadratic, multiplicative (power) functional forms - translog, and transcendental functional forms - CES .

UNIT II: Economicoptimum

Conceptual and empirical issues in specification, estimation and application of production functions - Analytical approaches to economic optimum - determination of economic optimum with constant and varying input and output prices - economic optimum with production function analysis - input use behaviour.

UNIT III: Decisionmakingunder differentsituations

Decision making with multiple inputs and outputs – MRT and product relationships -cost of production and adjustment in output prices -single input and multiple product decisions - multi input, and multi product production decisions - decision making with no risk - cost of wrong decisions – cost curves – principles and importance of duality theory - correspondence of production, cost, and profit functions - principles and derivation of demand and supply functions.

UNIT IV: Economicefficiency

Technology, input use and factor shares - effect of technology on input use decomposition analysis -factor shares -estimation methods - economic efficiency in agricultural production – technical, allocative and economic efficiency – measurement - yield gap analysis – concepts and measurement - Risk and uncertainty in agriculture – incorporation of risk and uncertainty in decision making –risk and uncertainty and input use level – risk programming.

UNIT V: Programingtechniques

Simulation and programming techniques in agricultural production - multiple course objective programming – goal programming and compromise programming – applications. **Current streams of thought**

Practical

Estimation of different forms of production functions - Optimal input and product choice from estimated functions – Derivation of demand and supply functions and estimation – Estimation of cost function and interpretations – Optimal product and input choice under multi input and output system - Estimation of factor shares from empirical functions estimated - Estimating production

functions incorporating technology changes - Decomposition analysis and incorporation of technology – Estimation of efficiency measu res – Stochastic, probabilistic and deterministic frontier production functions - Risk programming – MOTAD - Quadratic programming -Simulation models for agricultural production decisions - Goal programming.

Theory lecture schedule

1. Production functions - components, assumptions
2. Properties and their economic interpretation - concept of homogeneity
3. APP, MPP, elasticities of substitution and their economic relevance
4. Production relations – optimality
5. Commonly used functional forms - nature, properties, limit ations
6. Estimation and interpretation - linear, Spillman
7. Cobb Douglas, quadratic, multiplicative (power) functional forms
8. Translog,transcendental functional forms and CES
9. Economic optimum
10. Conceptual and empirical issues in specification
11. Estimation and appl ication of production functions
12. Analytical approaches to economic optimum
13. Determination of economic optimum with constant and varying input and output prices
14. Economic optimum with production function analysis
15. Input use behavior
16. Decision making under different situations
17. Decision making with multiple inputs and outputs
18. **Mid Semester Examination**
19. MRT and product relationship s
20. Cost of production and adjustment in output prices
21. Single input and multiple product decisions
22. Multi input, and multi product production decisions
23. Decision making with no risk - cost of wrong decisions
24. Cost curves
25. Principles and importance of duality theory - correspondence of production, cost, and profit functions
26. Principles and derivation of demand and supply functions
27. Economic efficiency, technology
28. Input use and factor shares -effect of technology on input use

29. Decomposition analysis -factor shares -estimation methods
30. Economic efficiency in agricultural production –technical, allocative and econo mic efficiency – measurement
31. Yield gap analysis – concepts and measurement
32. Risk and uncertainty in agriculture – incorporation of risk and uncertainty in decision making – risk and uncertainty and input use level –risk programming .
33. Simulation and programming techniques in agricultural production - multiple course objective programming
34. Goal programming and compromise programming – applications.

Practicalschedule

1. Estimation of different forms of production functions
2. Optimal input and product choice from estimated functions
3. Derivation of demand and supply functions
4. Derivation of cost function from production function
5. Estimation of cost function and interpretations
6. Optimal product choice under multi input and output system
7. Optimal input choice under multi input and output system
8. Estimation of factor shares from empirical functions
9. Estimating production functions incorporating technology changes
10. Decomposition analysis and incorporation of technology
11. Estimation of efficiency measures – Sto chastic frontier
12. Probabilistic frontier
13. Determinist ic frontier production function
14. Risk programming – MOTAD
15. Quadratic programming
16. Simulation models for agricultural production decisions
17. Goal programming.

Course Outcomes

At the end of the course students will be able to

CO1: Differentiate technological, allocative and economic efficiency and applications

CO2: Understand and apply production and cost function and implication for profit maximization in the short and long run

CO3: Analyze market structure and implications for profit maximization

CO4: Apply production theory to practical problems such as agricultural supply response

CO5: Quantify risk and uncertainty in agricultural production

CO – PO Mapping

	PO1	PO2	PO3
CO1	3		3
CO2		3	3
CO3	2	3	
CO4	3		
CO5			3

References

1. Bruce R. Beattie, Charles Robart Taylor and Myles J. Watss , (2009), *The Economics of Production* , Krieger Publishing Company, New Delhi.
2. Chambers ,RG. ,(1988),*Applied Production Analysis ,* Cambridge Univ. Press.
3. David L. Debertin, (2012), *Agricultural Production Economics* , Create Space Independent Publishing Platform, New Delhi.
4. David Ludden , (2005) , *Agricultural Production and South Asian History* , Oxford Indian Paper Books, New Delhi.
5. Dhaka, J.M., (2010), *Econom ics of Agricultural Production and Farm Management* , Aaviskar .
6. KanishkaBedi, (2013), *Production an Operation Management* , Oxford University Press .
7. Palanisami, K., P. Paramasivam and C.R. Ranganathan, (2016), *Agricultural. Production Economics Analytical Meth ods and Applications* , Associated Publishing Company , Chennai
8. Pannerselvam, (2012), *Production and Operation Management* , Prentice Hall India Learning Private Limited, New Delhi.
9. Ronald William Shepherd, (2016), *Theory of Cost and Production Economics* , Princeton University Press .
10. YacobKhojasteh, (2017), *Production Management: Advanced Models, Tools and Applications for Full System* , McGraw Hill, New Delhi.

AEC 814 Advanced Agricultural Marketing and Price Analysis (2+1)

Learning **Objectives**

- This course aims at teaching the students about the various principles and dynamic changes of Agri marketing
- To explain price analysis with their application at both micro and macro levels

Theory

UNIT I: Market analysis

Importance of market analysis in the agricultural system - types of marketing - advantages and disadvantages - quantitative estimation – the distinguishing characteristics and role of agricultural prices – data sources for agricultural products and prices - software used in market analysis.

UNIT II: Market institutions

Role of various formal institutions in agricultural marketing - and functions - measuring their efficiency - public - private partnership – institutional arrangements. Successful casestudies.

UNIT III: Market integration

Multi market estimation, supply response models. Market integration and price transmission -supply/value chain management. GAP analysis. Current trends in information in the changing agri food system.

UNIT IV: Spot and future market

Agricultural commodity market ing - spot and futures - marketing of derivatives - speculation, hedging, swap, arbitrage etc. commodity exchanges - price discovery and risk management in commodity markets - Regulatory mechanism of futures trading.

UNIT V: Econometricmodelsin agriculturalmarketing

Lag operators and difference equations; stationary and stochastic processes - UNIT roots and cointegration - conditional heteroscedasticity - ARCH and GARCH models – forecast evaluation - methods of forecasting. Price indices and econometric estimation and simulation.

Current streams of thought

Practical

Estimation of demand/ supply forecasting, supply chain / value chain analysis for different commodities - Commodity models multi market estimation - time series analysis - market integration studi es- price discovery price volatility estimation – commodity price forecasting using econometric software.

Theory lecture schedule

1. Market analysis - importance of market analysis in the agricultural system

2. Types of marketing - advantages and disadvantages
3. Quantitative estimation
4. Distinguishing characteristics of agricultural prices
5. Role of agricultural prices
6. Data sources for agricultural products and prices
7. Software used in market analysis
8. Market institutions
9. Role of various formal institutions in agricultural marketing
10. Functions of formal institutions
11. Measuring their efficiency
12. Public - private partnership , institutional arrangements
13. Successful case studies
14. Market integration
15. Multi market estimation
16. Supply response models
17. Market integration and price transmission
18. **Mid Semester Examination**
19. Supply/value chain management
20. GAP analysis
21. Current trends in the changing agri food system
22. Spot and future market
23. Agricultural commodity marketing
24. Marketing of derivatives, speculation, hedging, swap, arbitrage etc.
25. Commodity exchanges
26. Price discovery and risk management in commodity markets
27. Regulatory mechanism of futures trading
28. Econometric models in agricultural marketing
29. Lag operators and difference equations
30. Stationary and stochastic processes
31. UNIT roots and cointegration
32. Conditional heteroscedasticity , ARCH and GARCH models
33. Forecast evaluation - methods of forecasting
34. Price indices and econometric estimation and simulation.

Practicalschedule

1. Estimation of demand function

2. Estimation of supply function
3. Supply chain / value chain analysis for different commodities
4. Commodity models
5. Multi market estimation
6. Time series analysis
7. Market integration studies
8. Price discovery
9. Price volatility estimation
10. Methods of forecasting demand
11. Methods of forecasting supply
12. Commodity price forecasting using econometric software
13. Cointegration analysis
14. ARCH and GARCH models
15. Estimation of price indices
16. Simulation technique
17. Supply response model

Course Outcomes

At the end of the course students will be able to

CO1: Use marketing concepts for analyzing market structures and performance **a**nd formulate effective agricultural marketing policy.

CO2: Apply theoretical models of imperfect market structures to inform public policy.

CO3: Appraise organizational forms unique to agricultural industries.

CO4: Understand price discovery mechanism under differentiate market structures.

CO5: Forecast price for different products

CO – PO Mapping

	PO1	PO2	PO3
CO1		3	3
CO2	3		
CO3	2	3	3
CO4		2	
CO5	2		3

References

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AEC 821 Advanced Econometrics (2+1)

LearningObjectives

- To impart knowledge on advanced econometric tools to the students of agricultural economics
- To analyze the economic problem by applying quantitative techniques.

Theory

UNIT I: Classicalregressionmodel

Review of classical regression model – assumption – OLS estimation in CLR model – review of hypothesis testing –restrictions on parameters – single equation techniques.

UNIT II:Ordinaryleast squares

Ordinary least squares – weighted least squares – generalized least squares – method of principal components – instrumental variables method - maximum likelihood method – errors in variables, non-linearity and specification tests – nonspherical error terms.

UNIT III: Dummy variables

Introduction - Qualitative and truncated dependent variables – limited dependent variables –LPM, probit and logit models, their multinomial extensions.

UNIT IV: Models for panel data

Autoregressive distributed lag models – panel data fixed and random effects models and their extensions.

UNIT V: Indirectleast squares

Simultaneous equation methods –identification – estimation by indirect least squares 2SLS, PIML, SURE, 3SLS. **Current streams of thought**

Practical

Estimation of multiple regression model - GLS estimation methods – testing misspecification errors – Testing and managing multicollinearity, heteroscedasticity and autocorrelation - estimation of LPM, Logit and Probit models - comparing two regressions - Chow test - estimation of distributed lag models – panel data random and fixed effects models - Indirect least squares 2SLS, SURE, 3SLS, estimation of simultaneous equation models

Theory lecture schedule

1. Econometrics – basic concepts
2. Regression and correlat ion – basics
3. Classical regression model – introduction
4. Review of classical regression model – assumption
5. Auto correlation , Heteroscedasticity
6. Selection of variables

7. OLS estimation in CLR model
8. Review of hypothesis testing
9. Restrictions on parameters
10. Single equation techniques
11. Weighted least squares
12. Generalized least squares
13. Method of principal components
14. Instrumental variables method
15. Maximum likelihood method
16. Errors in variables
17. Non-linearity and specification tests
18. **Mid Semester Examination**
19. Nonspherical error terms
20. Dummy variables - introduction
21. Qualitative and truncated dependent variables
22. Limited dependent variables –LPM
23. Probit model
24. Logit model
25. Time series data and panel data
26. Models for panel data
27. Autoregressive distributed lag models
28. Panel data fixed and random effects models and their extensions
29. Indirect least squares – introduction
30. Simultaneous equation methods –identification
31. Estimation by indirect least squares - 2SLS
32. Estimation by PIML
33. Estimation by SURE
34. Estimation by 3SLS

Practicalschedule

1. Identification of variables
2. Estimation of multiple regression model
3. GLS estimation methods
4. Testing misspecification errors
5. Testing and Managing multicollinearity
6. Heteroscedasticity

7. Autocorrelation
8. Estimation of LPM
9. Logit model
10. Probit model
11. Comparing two regressions - Chow test
12. Estimation of distributed lag models
13. Panel data - random and fixed effects models
14. Indirect least squares 2SLS
15. ILS – SURE
16. ILS - 3SLS
17. Estimation of simultaneous equation models

Course Outcomes

At the end of the course students will be able to

CO1: Develop the necessary skills needed for empirical research using econometrics techniques.

CO2: Conduct independent research using secondary data.

CO3: Deepen their other transferable skills such as written communication, teamwork, numeracy, computer library, problem solving and analytical skills.

CO4: Identify the appropriate research design for different research problem.

CO5: Interpret the results and write research report & research articles

CO – PO Mapping

	PO1	**PO2**	**PO3**
CO1	3		3
CO2		3	3
CO3		3	
CO4	3		
CO5			3

References

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AEC 822 Agricultural Development and Policy Analysis (3+0)

Learning **Objectives**

- To impart an indepth knowledge and analytical thinking and various development in agriculture
- To understand recent trends in agriculture related policy analysis

Theory

UNIT I: Theories of growth

Introduction to theories of growth –Harrod -domar model –slow model – cass-yarn model – Cambridge school of thought – Neuman growth model – Kaldors' model of growth – the new endogenous growth theory – policy framework – goals, values and beliefs – welfare maximization – characteristics of under development and agricultural develo pment.

UNIT II: Theories of development

Introduction to theories of development – classical and conservation theories – rostow theory – marx theory – schumpeter theory – urban industrial model and lead sector – induced innovation model – high pay off input model and multi sector – role of state economic development.

UNIT III: Agricultural policy

Economic and agricultural situation during plan periods and policy implications – sectoral allocation policies –policies related to major agricultural commodities – policies on resource development conservation and exploitation – energy needs for agricultural / rural development – agricultural wage policy – infrastructural support for agriculture – transport, storage and markets.

UNIT IV: Market policy

Market – policy and state – state Vs market – failure of policy – failure of markets – rationale for government intervention – demand analysis for policy making – alternative approaches to demand analysis – policy implication. Supply response – approaches to measure ment of supply response – nerlovian models of supply response – policy implications.

UNIT V: Development planning and policy modeling

Meaning of economic planning – plan formulation – controls under planning – transfer of technology – investment criteria in economic development – economic planning and price mechanism – price, trade and international assistance – agricultural taxation trade – off between agricultural development and environment quality – policy modeling for agricultural support – structural transformation . **Current streams of thought**

Theory lecture schedule

1. Introduction to theories of growth
2. Harrod -domar model –slow model
3. Cass -yarn model

4. Cambridge school of thought
5. Neumangrowth model
6. Kaldors' model of growth
7. New endogenous growth theory
8. Policy framework – goals, values and beliefs
9. Welfare maximization
10. Characteristics of under development and agricultural development
11. Introduction to theories of development
12. Classical and conservation theories – Rostow theory
13. Marx theory
14. Schumpeter theory
15. Urban industrial model and lead sector
16. Induced innovation model
17. High pay off input model and multi sector
18. Role of state economic development
19. Agricultural policy
20. Economic and agricultural situation during plan periods and policy implications
21. Sectoral allocation policies
22. Policies related to major agricultural commodities
23. Policies on resource development
24. Policies on resource conservation and exploitation
25. Energy needs for agricultural / rural development
26. **Mid Semester Examination**
27. Agricultural wage policy
28. Infrastructural support for agriculture – transport
29. Storage and markets
30. Market policy and state
31. State vs market
32. Failure of policy
33. Failure of markets
34. Rationale for government intervention
35. Demand analysis for policy making
36. Alternative approaches to demand analysis
37. Policy implication
38. Supply response

39. Approaches to measurement of supply response
40. Nerlovian models of supply response
41. Policy implications
42. Development planning and policy model ing
43. Meaning of economic planning – plan formulation
44. Controls under planning – transfer of technology
45. Investment criteria in economic development
46. Economic planning and price mechanism
47. Price, trade and international assistance
48. Agricultural taxation
49. Tra de – off between agricultural development and environment quality
50. Policy modeling for agricultural support
51. Structural transformation.

Course Outcomes

At the end of the course students will be able to

CO1: Provide orientation to the students in economic development.

CO2: Provide orientation on theories of policy analyze in developing countries.

CO3: Understand the agricultural policy development.

CO4: Understand the globalization and liberalization.

CO5: Discuss various development issues and identify the policy options for sustainable agricultural development.

CO – PO Mapping

	PO1	PO2	PO3
CO1	3		3
CO2	2	3	
CO3		3	3
CO4	3		
CO5			3

References

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AEC 823 Environmental Economics (2+1)

LearningObjective

- To provide an advanced treatment of the economic theory of environmental management and policy, externalities and market and non - market approaches to environmental improvement.

Theory

UNIT I: Environmentalpollution

Environmental pollution - causes and consequences – externalities - public goods and externalities – economics of pollution – private vs social cost of environmental pollution – property rights, environment and development – theory of environmental policy.

UNIT II: Cost benefit analysis

Environmental cost benefit analysis - environmental impact assessment techniques - non-market valuation of environmental resources (WTP / WTA) - environment, market and social welfare.

UNIT III: Economicgrowth and environmentalcost

Growth oriented economic policies and their environmental impacts - population and environmental quality - poverty and environmental degradation – sustainable development – indicators of sustainable development – issues in sustainabledevelopment.

UNIT IV: Environmentalpolicy

Environment and ecology - environmental accounting – environmental pollution with respect to water and air - land and forest resources related environmental pollution - coastal externalities - urbanization and environment . Basic approaches to environmental policy (tax, subsidy, pollution permits etc.) green taxes - political economy of environmental regulation and management.

UNIT V: Globalwarming

Transboundary environmental problems - economics of global warming, climate change and emission trading - environment, international trade and development. **Current streams of thought**

Practical

Contemporary global environmental issues, movement, policies, programmes, laws and other regulatory mechanisms – criteria for evaluating the environment related projects and review of Environmental Impact Assessment (EIA) techniques - recreation demand models of environmental valuation - contingent valuation techniques – environmental resource accounting techniques - discussion on the techniques dealing with air pollution and review of case studies on air pollution and its impacts - forest environment and wild life conservation -

green GDP and greenhouse insurance – practical considerations and comparison of instruments of environmental policy - non-point source pollution control methodologies - environment in macroeconomic modeling - meta-analysis, economic valuation and environmental economics - multi-criteria methods for quantitative, qualitative and fuzzy evaluation problems related to environment - input output analysis, technology and the environment -computable general equilibrium models for environmental economics and policy analysis.

Theory lecture schedule

1. Environmental pollution – introduction
2. Environmental pollution – air, water, soil.
3. Causes and consequences
4. Externalities - public goods and externalities
5. Economics of pollution
6. Private vs. social cost of environmental pollution
7. Property rights, environment and development
8. Theory of environmental policy
9. Environmental cost benefit analysis
10. Environmental impact assessment techniques
11. Non-market valuation of environmental resources
12. Environment, market and social welfare
13. Economic growth and environmental cost
14. Growth oriented economic policies
15. Environmental impacts of economic policies
16. Population and environmental quality
17. Poverty and environmental degradation
18. **Mid Semester Examination**
19. Sustainable development
20. Indicators of sustainable development
21. Issues in sustainable development
22. Enviro nmental policy
23. Environment and ecology
24. Environmental accounting
25. Environmental pollution with respect to water and air
26. Land and forest resources related environmental pollution
27. Coastal externalities
28. Urbanization and environment

29. Basic approaches to environmental policy
30. Green taxes - political economy of environmental regulation and management
31. Global warming - causes and effects
32. Transboundary environmental problems
33. Economics of global warming, climate change and emission trading
34. Environment, international trade and development.

Practicalschedule

1. Contemporary global environmental issues, movement, policies, programmes, laws and other regulatory mechanisms
2. Criteria for evaluating the environment related projects
3. Review of Environmental Impact Assessment (EIA) techniques
4. Demand models of environmental valuation
5. Contingent valuation techniques
6. Environmental resource accounting techniques
7. Discussion on the techniques dealing with air pollution
8. Review of case studies on air pollution and its impacts
9. Forest environment and wild life conservation
10. Green GDP and greenhouse insurance
11. Practical considerations and comparison of instruments of environmental policy
12. Non-point source pollution control methodologies
13. Environment in macroeconomic modeling - meta-analysis, economic valuation
14. Multi-criteria methods for quantitative, qualitative and fuzzy evaluation
15. Problems related to environment – input output analysis
16. Technology and the environment
17. Computable general equilibrium models for environmental economics and policy analysis.

Course Outcomes

At the end of the course students will be able to

CO1: Understand the evaluation of environmental benefits

CO2: Analyze economic problems related to natural resource use including climate change problems.

CO3: Assess the ways to manage common property resources.

CO – PO Mapping

	PO1	PO2	PO3
CO1	3		3
CO2		3	3
CO3		3	

References

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AEC 824 Agricultural Finance and Project Management (2+1)

LearningObjectives

- To impart knowledge on issues related to lending to priority sector credit management and financial risk management.
- To understand various appraisal techniques in project management .

Theory

UNIT I: Role and importanceof agriculturalfinance

Introduction of concepts in agricultural finance. Financial Institutions and credit flow to rural/priority sector. Agricultural lending – direct and indirect financing – financing through co-operatives, NABARD and commercial banks and RRBs. District credit plan and lending to agriculture/priority sector. Micro-financing and role of MFIs - NGOs, and SHGs.

UNIT II: Principles of credit

The concept of 5 C's, 7 P's and 3 R's of credit. Estimation of technical feasibility, economic viability and repaying capacity of borrowers and appraisal of credit proposals. Understanding lenders and developing better working relationshi p and supervisory credit system. Credit inclusions –credit widening and credit deepening.

UNIT III:Financialstatements

Financial decisions – investment, financing, liquidity and solvency. Preparation of financial statements - balance sheet, cash flow stat ement and profit and loss account. Ratio analysis and assessing the performance of farm/firm.

UNIT IV:Appraisalof projects

Financial, economic and environmental appraisal of investment projects. Identification, preparation, appraisal, financing and implementation of projects. Project appraisal techniques – undiscounted measures. Time value of money – use of discounted measures – B:C ratio, NPV and IRR. Agreements, supervision, monitoring and evaluation phases in appraising agricultural investment pro jects. Net work techniques – PERT and CPM.

UNIT V: Risks in financingagriculture

Risk management strategies and coping mechanism. Crop Insurance programmes – review of different crop insurance schemes - yield loss and weather based insurance and their applications. **Current streams of thought**

Practical

Development of Rural Institutional Lending - branch expansion, demand and supply of institutional agricultur al credit and over dues and loan waiving - An overview, rural lending programmes of commercial banks, lead bank scheme - preparation of district credit plan, rural lending programmes of co-operative lending institutions, preparation of financial statements using farm/firm level data, farm credit appraisal techniques and farm financial analysis through financial statements, performance of micro financing institutions – NGOs and self-help

groups , identification and formulation of investment projects, project appraisal techniques – undiscounted measures and their limitations. Project appraisal techniques – discounted measures, network techniques – PERT and CPM for project management, case study analysis of an agricultural project, financial risk and risk managem ent strategies – crop insurance schemes, financial instruments and methods – e banking, kisan credit cards and core banking.

Theory lecture schedule

1. Role and importance of agricultural finance
2. Introduction of concepts in agricultural finance
3. Financial institutions
4. Credit flow to rural/priority sector
5. Agricultural lending – direct and indirect financing
6. Financing through co-operatives
7. NABARD
8. Commercial banks and RRBs
9. District credit plan and lending to agriculture/priority sector
10. Micro -financing and role of MFIs - NGOs, and SHGs
11. Principles of credit
12. Concept of 5 C's, 7 P's and 3 R's of credit
13. Estimation of technical feasibility , economic viability and repaying capacity of borrowers
14. Appraisal of credit proposals
15. Understanding lenders and developing better working relationship
16. Supervisory credit system
17. Credit inclusions –credit widening and credit deepening
18. **Mid Semester Examination**
19. Financial statements
20. Financial decisions
21. Investment, financing, liquidity and solvency
22. Preparation of financial statements - balance sheet, cash flow statement and profit and loss account
23. Ratio analysis and assessing the performance of farm/firm
24. Appraisal of projects
25. Financial, economic and environmental appraisal of investment projects
26. Identification, preparation, appraisal, financing and implementation of projects

27. Project appraisal techniques – undiscounted measures
28. Time value of money
29. Use of discounted measures – B:C ratio, NPV and IRR
30. Agreements, supervision, monitoring and evaluation phases in appraising agricultural investment projects
31. Network techniques – PERT and CPM
32. Risks in financing agriculture
33. Risk management strategies and coping mechanism
34. Crop Insurance programmes – review of different crop insurance schemes - yield loss and weather based insurance and their applications.

Practicalschedule

1. Rural Institutional Lending
2. Demand and supply of institutional agricultural credit, over dues and loan waiving
3. Rural lending programmes of commercial banks
4. Lead bank scheme, district credit plan
5. Rural lending programmes of co-operative lending institutions
6. Preparation of financial statements using farm/firm level data
7. Farm credit appraisal techniques
8. Farm financial analysis through financial statements
9. Performance of micro financing institutions – NGOs, self-help groups
10. Identification and formulation of investment projects
11. Project appraisal techniques – undiscounted measures and their limitations
12. Project appraisal techniques – discounted measures
13. Network techniques – PERT and CPM for project management
14. Case study analysis of an agricultural project
15. Financial risk and risk management strategies
16. Crop insurance schemes, financial instruments and methods
17. E-banking, kisan credit cards and corebanking.

Course outcomes

At the end of the course students will be able to

CO1: Understand the principles of agricultural finance lending

CO2: Understand the procedure to repay the loan.

CO3: Know the way to monitor agricultural project.

CO4: Understand project appraisal techniques.

CO5: Understand the e-banking and credit card

CO– PO Mapping

	PO1	PO2	PO3
CO1	3		3
CO2		2	3
CO3		2	
CO4	3		
CO5			3

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AEC815 Natural Resource Management(2+1)

Learning Objective

- To focus on the economic analysis of natural resources and seeks to identify
- To solve natural resource management problems via mathematical approach using dynamic optimization techniques.

Theory

UNIT I: Classification of natural resources

Natural resources – definition – characteristics and classification. Stock dynamics of renewable and non-renewable resources. Equation of motion for renewable and non- renewable resources. Fundamental equation of renewable resources – application of institutional economic concepts in natural resource management.

UNIT II: Optimum use of resources

Growth curves of fishery and forest resources. The role of time preference in natural resource use. Simple two-period model of optimal use of renewable and non-renewable resources. Advanced models of optimal resource use – Static Vs. dynamic efficiency in natural resource use Applications of dynamic programming and optimal control.

UNIT III: Economics of groundwater use

Optimal extraction of groundwater. Analytical and numerical solutions for optimal inter-temporal allocation of natural resources. Optimal harvesting of single rotation and multiple rotation forests. Optimal management of fishery.

UNIT IV: Natural resources and property rights

Property rights in natural resources and their implication for conservation and management of natural resources. Management of common property natural resources – Institutional arrangements for conservation and management of common pool fishery, groundwater and forestry resource.

UNIT V: Valuation of natural resources

Resource scarcity – Natural resource degradation – Poverty and resource degradation – Natural resource accounting - Pricing and valuation of natural resources – Natural resources policy. **Current streams of thought**

Practical

Derivation of the fundamental equation of renewable resources – Estimation of growth curves and stock dynamics for fishery and forestry resources. Simple two period problem of optimal resource use – Numerical solution for simple two-period model of dynamic efficiency in natural resource extraction. Multi-period dynamic efficiency – Using Excel Solver in solving dynamic natural resource harvesting problems. Using analytical solution procedures for solving natural resource management problems – Optimal control.

Theory lecture schedule

1. Natural resources -definition -characteristics
2. Classification of natural resources
3. Stock dynamics of renewable and non-renewable resources
4. Equation of motion for renewable and non- renewable resources
5. Fundamental equation of renewable resources
6. Application of institutional economic concepts in natural resource management
7. Optimum use of resou rces
8. Growth curve of fishery resource
9. Growth curve of forest resource
10. Role of time preference in natural resource use
11. Simple two-period model of optimal use of renewable resource
12. Two model of optimal use of non-renewable resource
13. Advanced models of optim al resource use
14. Static vs. dynamic efficiency in natural resource use
15. Applications of dynamic programming and optimal control
16. Economics of groundwater use
17. Optimal extraction of groundwater
18. **Mid Semester Examination**
19. Analytical and numerical solutions for optimal inter-temporal allocation of natural resources
20. Optimal harvesting of single rotation forests
21. Multiple rotation forests
22. Optimal management of fishery
23. Natural resources and property rights
24. Property rights in natural resources and their implication for conservation and management of natural resources
25. Management of common property natural resources
26. Institutional arrangements for conservation and management of common pool fishery
27. Institutional arrangements for conservation and management of groundwa ter
28. Institutional arrangements for conservation and management of forestry resource
29. Valuation of natural resources
30. Resource scarcity – Natural resource degradation
31. Poverty and resource degradation
32. Natural resource accounting

33. Pricing and valuation of natural resources
34. Natural resources policy

Practicalschedule

1. Derivation of the fundamental equation of renewable resources
2. Estimation of growth curve and stock dynamics for fishery
3. Growth curve of forestry resource
4. Simple two period problem of optimal resource use
5. Numerical solution for simple two -period model of renewable resource
6. Numerical solution for simple two -period model of non renewable resource
7. Dynamic efficiency in natural resource extraction
8. Multi -period dynamic efficiency
9. Solvin g dynamic natural resource using economic software
10. Using analytical solution procedures for solving natural resource management problems
11. Optimal control
12. Valuation of natural resources
13. Resource scarcity – Natural resource degradation
14. Natural resources poli cy
15. Natural resources and property rights
16. Economics of groundwater use .
17. Optimal extraction of groundwater

Course Outcomes

At the end of the course students will be able to

CO1: Analyze economic problems related to natural resource use including climate change problems.

CO2: Understand environmental legislations in India.

CO3: Analyse economic problems related to natural resource use including climate change problems.

CO – PO Mapping

	PO1	PO2	PO3
CO1		3	3
CO2	3		
CO3			3

References

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AEC 825 International Trade and Intellectual Property Management (2+1)

Learning **Objectives**

- To inculcate the students a thorough knowledge on various aspects of international trade and intellectual property rights
- To prepare them to meet the challenges of agrl. sector in the present WTO regime

Theory

Unit-I: International trade – concepts

Basic concepts – classical trade theory – introduction to neo-classical trade theory – supply side analysis – opportunity cost: trade under increasing opportunity costs-factor endowments; trade and factor prices – factor price equalization-demand side analysis; community indifference curves-demand and international trade-integration of demand and supply-offer curve analysis - general equilibrium - equilibrium in product and factor markets.

Unit-II: Theories in international trade

Application of trade theory-terms of trade – supply and demand shifts-technological change – factor supplies and trade; factor intensities; transport costs, location – trade with many goods and countries; leontief paradox; human skills; technological gaps-product cycle – scale economies. Trade policies – instruments, impacts of trade policies – economic integration and regional groupings-introduction to international finance-balance of trade and balance of payments-foreign exchange market – transactions, determination of foreign exchange rates.

Unit-III: International trade organizations

International economic organizations – IMF, World Bank, IDA , IFC, ADB – their role in international trade and terms of trade-international trade agreements Uruguay round – GATT, WTO – their role in promotion of trade-agrl. Export and import policies of India – role of State Trading Corporation - export promotion organizations-Export Promotion Zones (EPZ) – Agrl. Export Zones (AEZ) – EXIM bank.

Unit-IV: Intellectual property rights – meaning and concepts

Introduction to IPR – benefits of IPR – environment implications of IPR – status of India's IPR registration – TRIPS – WIPO – laws and acts related to IPR – Indian patent act – trademark act – geographical indications of good act – designs act – international intellectual property law – registration of plant varieties and essentially derived variety – license – tribunal – patent office – role of department of industrial policy and promotion - protection of plant varieties and farmers' rights act.

Unit-V: IPR in agriculture

IPR in agriculture – patents and copyrights – patents – patent system in India – designs – copyrights – trademark – geographical indications – India's plant variety bill – patent disputes – complete specification – bio piracy – patenting of microbiological

inventions – bio safety protocol – economic implications of genetically modified organisms.

Current streams of thought

Practical

Assessing the performance and export marketing strategies for fruits and vegetables, cut flowers, tea, coffee and medicinal and aromatic plants – market composition of commodity export – major destination and export instability – Markov chain analysis - export competitiveness – prices and non-price factors – import restraint and their impact on export – visiting a manufacturing center and observe production, packaging, quality control, labelling, method of pricing etc. – procedures for applying the patent application – case studies on basmati rice,turmeric, Bt cotton,Darjeeling tea, Kondapalli toys, Madurai jasmine etc. – directions of trade – India's foreign trade policy

Theory lecture schedule

1. International trade – basic concepts
2. Classical trade theory
3. Introduction to neo-classical trade theory
4. Supply side analysis: opportunity cost- trade under increasing opportunity costs
5. Factor endowments; trade and factor prices – factor price equalization
6. Demand side analysis; indifference curves-demand and international trade
7. Integration of demand and supply-offer curve analysis
8. General equilibrium-equilibrium in product and factor markets
9. Theories in international trade
10. Application of trade theory-terms of trade
11. Supply and demand shifts-technological change
12. Factor supplies and trade; factor intensities
13. Transport costs, location
14. Trade with many goods and countries - Leontief paradox
15. Human skills, technological gaps
16. Product cycle – scale economies
17. Trade policies – instruments, impacts of trade policies
18. **Mid Semester Examination**
19. Economic integration and regional groupings
20. Introduction to international finance - balance of trade and balanceofpayments
21. Foreign exchange market – transactions, determination of foreign exchange rates
22. International trade organizations
23. International economic organizations – IMF, World Bank
24. IDA , IFC, ADB – their role in international trade and terms of trade
25. International trade agreements - Uruguay round – GATT
26. WTO – their role in promotion of trade
27. Agrl. Export and import policies of India – role of State Trading Corporation
28. export promotion organizations - Export Promotion Zones (EPZ) – Agrl. Export Zones (AEZ) – EXIM bank
29. Intellectual property rights – meaning and concepts– benefits of IPR – environment implications of IPR
30. Status of India's IPR registration – TRIPS – WIPO – laws andacts related toIPR
31. Indian patent act – trademark act – geographical indications of good act – designs act – international intellectual property law
32. Registration of plant varieties and essentially derived variety – license – tribunal – patent office – role of department of industrial policy and promotion - protection of plant varieties and farmers' rights act
33. IPR in agriculture – patents and copyrights – patents – patent system in India –

designs – copyrights – trademark – geographical indications – India's plant variety bill – patent disputes – complete specification

34. Bio piracy – patenting of microbiological inventions – bio safety protocol – economic implications of genetically modified organisms.

Practical schedule

1. Assessing the performance and export marketing strategies for fruits and vegetables
2. Export performance of cut flowers
3. Export performance of tea, coffee
4. Export performance of medicinal and aromatic plants
5. Market composition of commodity export
6. Major destination and export instability
7. Markov chain analysis
8. Export competitiveness – prices and non-price factors
9. Import restraint and their impact on export
10. Visiting a manufacturing center and observe production, packaging, quality control, labelling, method of pricing etc.
11. Procedures for applying the patent application
12. Case studies on basmati rice, turmeric
13. Case studies on Bt cotton, Darjeeling tea
14. Case studies on Kondapalli toys, Madurai jasmine
15. Role of export promotion organisations
16. Direction of trade
17. India's foreign trade policy

Course Outcomes

At the end of the course students will be able to

CO1: Understanding the international business and management

CO2: Understand the procedure to obtain patent rights.

CO3: Know the way to protect extinct varieties.

CO4: Create awareness about geographical indications of goods and commodities.

CO5: Identify the ways to commercialize intellectual properties

CO – PO Mapping

	PO1	**PO2**	**PO3**
CO1	3		3
CO2		2	3
CO3		3	
CO4	2		
CO5			2

References

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2. Ahuja, V.K., (2017), *Law Relating to Intellectual Property Rights*, Lexis Nexis, New Delhi.
3. Francis Cherunilam, (2004), *International Economics*, Tata McGraw Hill Publishing Company, New Delhi.
4. Jhingan, M.L., (2006), *International Economics*, Vrinda Publications, New Delhi.
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6. Neeraj Pandey and KhushdeepDharni, (2014), *Intellectual Property Rights*, PHI Learning, New Delhi.
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STA 821 : Advanced Statistical Methods for Social Sciences (2+1)

Objective

- This course is aimed for students to get an exposure ons concepts of statistical methods, probability distribution and statistical inference.

Theory

Unit–I: Probability

Theory of probability, Random variable, mathematical expectation. Discrete and continuous probability distributions. Binomial, poisson, negative binomial, normal distribution and their applications.

Unit–II: Sampling Methods

Concept of sampling; SRS, stratified sampling, cluster sampling, PPS sampling, multistage sampling. Concept of sampling distribution chi-square, t, F. Tests of significance based on normal, t, Y^2 and F.

Unit–III: Correlation and Regression

Correlation and Regression: Simple and multiple linear regression model, estimation of parameters, predicted values and residuals. Partial correlation and multiple correlations, rank correlation, test of significance of correlation coefficient and regression coefficients.

Unit–IV: Non-Parametric Tests

Non-parametric tests - single and two sample problems. Friedman two-way ANOVA. Distribution free tests - advantages - disadvantages - run test - test for randomness - Median test - Sign test - Mann Whitney U test for two samples - Kolmogrov Smimov one sample and two sample test, Kruskal - Walli's test - chi-square - correlation coefficients - regression coefficients - Standard Error - Significance tests - Student's t and F distribution.

Unit–V: Discriminant Function

Hotelling's T^2, classification problems, discriminant function. D^2 statistics and its applications. Principal component analysis, canonical correlations. Cluster analysis and factor analysis. Simulation methods: Resampling methods jack knife and the bootstrap. MCMC methods and Gibbs sampler.

Practical

Estimation-Determination of sample size in simple random sampling-stratified random sampling-Cluster Sample-selection- Estimation-Multistage sampling-Selection-Estimation of parameters in two stage sampling-Determination of sample size in two stage sampling-Application of double sampling-Method of least squares-Moving averages-Kolmogrov-Smirnov test-Rank correlation coefficient-Forecasting using regression technique-Construction of index numbers of Agrl. production.

Theory Lecture Schedule

1. Theory of probability
2. Random variable
3. Mathematical expectation
4. Discrete and continuous probability distributions
5. Binomial
6. Poisson
7. Negative binomial
8. Normal distribution and their applications
9. Concept of sampling
10. SRS, stratified, cluster, PPS, multistage sampling
11. Concept of sampling distribution chi-square, t, F.
12. Tests of significance based on normal, t, Y^2 and F.
13. Correlation and Regression
14. Simple and multiple linear regression model
15. Estimation of parameters
16. Predicted values and residuals
17. **Mid semester examination**
18. Partial correlation
19. Multiple correlations
20. Rank correlation
21. Test of significance of correlation coefficient
22. Regression coefficients.
23. LS method
24. MLE method
25. Friedman two-way ANOVA
26. Hotelling's T^2
27. Discriminant function
28. D^2 statistics and its applications.
29. Principal component analysis
30. Canonical correlations
31. Cluster analysis and factor analysis.
32. Re-sampling methods jack knife and the bootstrap
33. Simulation methods
34. MCMC methods and Gibbs sampler

Practical Schedule

1. Sampling techniques - Simple random sampling - Estimation of mean and variance.
2. Cluster sampling, quota sampling, population proportionate to size sampling
3. Estimation of mean and variance in cluster sampling
4. Stratified sampling
5. Estimation of total and variance of total in two stage sampling with SRS at both stages
6. Estimation of moving trend by Moving average method and least square method
7. Estimation of seasonal variation by simple average method
8. Seasonal variation by ratio to trend method, Seasonal indices by link relative method
9. Non-parametric statistics an introduction
10. Run test and Sign test
11. Kolmogrov Smirnov one sample test and two sample test
12. Mann-Whitney U test and Kruskal Walli's test
13. Correlation coefficients of tests of significance
14. Regression coefficients of tests of significance
15. Construction of different weighted index numbers-Reversal test
16. Principal Component Analysis (PCA)
17. Cluster Analysis

Course Outcomes

CO1: It would enable the research students of agricultural sciences to understand the basic concepts of statistical methods.

CO2: To enhance the students' knowledge on fundamentals of sampling techniques and data analyses to make decision in the face of uncertainty.

CO3: It would give the exposure to perform the cause and effect relationship analysis to study the impact and influence of study variables are to be considered.

CO4: The students would be enriched their knowledge on non- parametric statistical analysis.

CO5: It would facilitate the students to pursue the advanced statistical analysis tools to apply in their research work.

CO – PO Mapping

	PO1	PO2	PO3
CO1			2
CO2	2		
CO3		3	2
CO4	2		3
CO5	2	3	3

References

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2. Biswas, S. (2001) - Topics in Statistical Methodology, New Delhi; New Age International Publishers Pvt. Ltd
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