VIDYASAGAR UNIVERSITY

Regulations, Curriculum & Syllabus

for

M. Sc (Agriculture) in Agronomy

[w.e.f.: 2021-2022]

Pradip Ghosh 12/5/22
Dr. Pradip Ghosh
Director
Midnapore City College
Midnapore, Paschim Medinipur
West Bengal

(Prof. Protit Bandyopadhyay BCKV)

Anulina Manna 12.05.22
Dr. Anulina Manna
Coordinator & Assistant Professor of Agriculture
Midnapore City College

(Prof. Ratikanta Ghosh BCKV)

12/5/22
Dr. Sudipta Chakrabarti
Principal
MIDNAPORE CITY COLLEGE
Kuturiya, Bhadutala, Paschim Medinipur
Pin- 721129, West Bengal, India

Kuntal Ghosh 12/5/22
DR. KUNTAL GHOSH
Assistant Professor in Microbiology
Department of Biological Sciences
MIDNAPORE CITY COLLEGE

Urvashi Bhattacharya 12.05.22

12.05.22

VIDYASAGAR UNIVERSITY

Common Academic Regulations for PG Programme
in
M. Sc. (Agriculture) in Agronomy &
M. Sc. (Agriculture) in Genetics & Plant Breeding

[w.e.f.: 2021-2022]

Common Academic Regulations for PG Programme

This regulation framed by the board of studies meeting which was held on 13.05.2022 at Midnapore City College as per the guidelines of ICAR & Vidyasagar University for running M.Sc. (Agriculture) in Agronomy and M.Sc. (Agriculture) in Genetics & Plant Breeding. This regulation may change as per requirement deemed to be fit at any BOS Meeting under the prior approval as framed time to time by the ICAR & Vidyasagar University. The details of the rules & regulations as mentioned herein below:

1. Eligibility for Admission

The students who have passed Bachelor's degree in Agricultural / Botany / Horticulture or Forestry with 50% marks for General and 45% marks for SC/ST category.

2. Academic Year and Registration

a. An academic year shall be normally from July to June of the following calendar year otherwise required under special situations. It shall be divided into two academic terms known as semesters. Dates of registration, commencement of instructions, semester end examination, end of semester and academic year, etc. will be implemented as per the Vidyasagar University norms.

b. The students shall register to the Vidyasagar University after the admission in the said course and the registration number will be issued by the Vidyasagar University.

3. Evolution System

a. Credit requirements

i. Framework of the courses

The following nomenclature and Credit Hrs need to be followed while providing the syllabus for all the disciplines:

Masters' Programme (Minimum credits)	
(i) Course work	
Major courses	20
Minor courses	06
Supporting courses	03
Common courses	06
Seminar	02
(ii) Thesis Research	20

Major courses: From the Discipline in which a student takes admission. Amongthe listed courses, the core courses compulsorily to be taken may be given *mark.

Minor courses: From the subjects closely related to a student's major subject.

Supporting courses: The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

Common Courses: The following courses (one credit each) will be offered to all students undergoing Master's degree programme:

- Library and Information Services
- Communicative English and thesis writing
- Intellectual Property and its management in Agriculture
- Basic Concepts in Laboratory Techniques
- Research Value and Ethics

Supporting Courses: The following courses are being offered by various disciplines (The list is only indicative). Based on the requirement, any of the following courses may be opted under the supporting courses. The syllabi of these courses are available in therespective disciplines. If required, the contents may be modified to suit the individualdiscipline with approval of the concerned BoS:

Course Title	Credit Hours
Mathematics for Applied Sciences	2+0
Statistical Methods for Applied Sciences	2+1
Experimental Designs	2+1

b. Mandatory requirement of seminars

- It has been agreed to have mandatory seminars one in Masters (Two Credits).
- The students should be encouraged to make presentations on the latest developments and literature in the area of research topic. This will provide training to the students on preparation for seminar, organizing the work, critical analysis of data and presentation skills.

c. Minimum Eligibility for Appearance in Examination

A regular student i.e. a student who has undergone a regular course of study in a college for the period specified for that course of study by having been on the rolls of the college immediately preceding the examination and has his/her name submitted to the Controller of Examinations by the college Principal where he/she has pursued the course for the examination and has fulfilled the following conditions to be certified by the college Principal concerned:

- He/she has been a student of good conduct.
- He/she has attended not less than 75% of the lecture delivered including seminars, tutorials etc. in each course opted by him/her in that semester.
- He/she has passed in previous semester.
- In the case of laboratory course/practical, he/she has attended not less than 75% of the practical classes conducted (practical include field studies, workshop practice, surveying etc.).

- He/she has paid the prescribed fee.

d. Scheme of Examination:

The evaluation of M.Sc. (Agriculture) in Agronomy and M.Sc. (Agriculture) in Genetics & Plant Breeding course contains two parts: Internal Assessment (IA) and End Semester Assessment (EA). The internal grade awarded to the students in the course in a semester shall be published on the notice board at least one week before the commencement of end semester examination. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teaches the course. There will be University Examinations at the end of each semester for both Theory and Practical. Semester End Examinations for all theory papers shall be set/prepared by the Controller of Examinations as per existing norms and evaluation of all theory papers courses shall be done by eligible faculty members set in the Board of Studies meeting held before the examination and under the supervision and coordination of the Chairman of BOS.

The students will learn 15 theory papers (Full Marks 50) and 15 practical papers (Full Marks 30) excluding Research paper (Full Marks 200) in total semester (it may be changed as per the recommendation of Board of Studies members and approved by the Hon'ble Vice Chancellor). The details of the syllabus should be approved by the Board of Studies members and or syllabus committee made for the course. The evaluation of a candidate shall be awarded and record thereof maintained in accordance with the Regulations prescribed:

Paper	Internal Assessment	End Semester	Total Marks
Theory	20	50	**100**
Practical	00	30	

Internal Assessment:

Categories	Class Assignment	Class Attendance	Internal exam*(IE)	Total
Number Distribution	05	05	10	**20**

*IE should be held two times. Best of the two should be awarded.

The questions pattern of theory will be as follows:

Component	Marks
05 Short Answer Type Questions out of 08 Questions. Each carries 02 marks.	**05×02=10**
05 Medium Answer Type Questions out of 08 Questions. Each carries 04 marks.	**05×04=20**
02 Long Answer Type Questions out of 05 Questions. Each carries 10 marks.	**02×10=20**

The questions pattern of practical will be as follows:

Component	**Marks**
2 experimental questions carries 5 marks each	**05×02=10**
Laboratory Note Book & Class Attendance	**10**
Viva-voce	**10**

e. Grading System:

Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) Based on the performance of the students, each student will be awarded Grade in each subject at the end of the semester following grading system on the base of 10 (ten). The letter grades and the corresponding grade points are as shown below:

Qualitative Evaluation	**Grade**	**% Scored in 100 Point Scale**	**Grade Points**
OUT STANDING	O	90 - 100	10
EXCELLENT	A	80 - 89	9
GOOD	B	70 - 79	8
AVERAGE	C	60 - 69	7
SATISFACTORY	D	50 - 59	6
FAILED	F	Below 50	0
ABSENT	Ab	0	0

Further there shall be another grade 'I' (with Point 0) for students for whom disciplinary actions remain pending. The Semester Grade Point Average (SGPA) will be computed in each semester as per the following formula:

SGPA (Si) = $\frac{\sum (Ci \times Gi)}{\sum Ci}$ Where Ci= Credit Point, Gi= Grade Point

C = The number of credits allotted for particular course. G = is the Grade points corresponding to the grade awarded for the course. i = 1,2,……., n represent the number of courses in which a student is registered in the concerned semester. The SGPA is rounded off to two decimal places. The Cumulative Grade Point Average (CGPA) will be computed at the end of each Semester as per the following formula:

CGPA=$\frac{\sum (Ci \times Si)}{\sum Ci}$

*C is the total credits of the corresponding semesters. S is the SGPA of the corresponding semesters. I = 1, 2… n represent the number of courses in which a student is registered in the concerned Semester. The CGPA is rounded off to two decimal places.

f. Rules for the Guidance of Candidates:

i. The final performance in a paper shall be taken as the total or aggregate of the marks obtained in internal assessment evaluation and the marks obtained at the End Semester Examinations.

ii. The qualifying marks for each theory paper shall be 50% and in the aggregate in each Semester it shall be 50%.

iii. A student who secures 50% in aggregate in a Semester but scores less than 50% in not more than two theory papers (Theory / Practical) shall be provisionally promoted to the next Semester, but declared failed in the papers in which he / she scores less than 50%. He / she shall be required to clear these back papers in next two chances. For these papers the qualifying marks shall be 50%.

iv. A student who does not secure 50% in aggregate in the Semester but secures 50% in all but two theory papers in the Semester, shall provisionally be promoted to the next Semester but declared failed in the papers in which he / she secured less than 50%. He / she shall be required to clear these back papers in next two chances subject to the condition stipulated in (h).

v. If students fail to qualify in more than two papers in a semester, he/she will have to repeat the semester in next academic session.

vi. A student may have a maximum of 4 back papers at any time of his/ her tenure.

vii. The back papers of the first, second and the third semester shall only be cleared with regular semester examination in the next academic session.

viii. The back papers of fourth semester shall be cleared in a special examination to be conducted within six weeks of the publication of the results or in the regular examination in the next academic session, to be decided by the Controller of Examination.

ix. A student shall have to qualify in all semester to qualify for the degree.

x. A student shall be allowed a maximum of consecutive four years to complete the two year Post-Graduate Programme of the University.

xi. Class/ Division will be awarded only in the Final Semester Examination.

Syllabus for M. Sc (Agriculture) in Agronomy

COURSE CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				TOTAL CREDIT	MARKS DISTRIBUTION			
		L	T	P	TOTAL		Int Asst.	End Sem	Practical	Total
#AGR -101	Modern Concepts in Crop Production	2		1	3	3	20	50	30	100
#AGR -102	Principles and Practices of Soil Fertility and Nutrient Management	2		1	3	3	20	50	30	100
#AGR -103	Principles and Practices of Weed Management	2		1	3	3	20	50	30	100
#AGR -104	Principles and Practices of Water Management	2		1	3	3	20	50	30	100
#AGR -105	Agrometeorology and Crop Weather Forecasting	2		1	3	3	20	50	30	100
#AGR -106	Agronomy of Major *kharif* Cereals and Pulses	2		1	3	3	20	50	30	100
*AGR -201	Agronomy of Oilseed, Fibre and Sugar Crops	2		1	3	3	20	50	30	100
*AGR-202	Agronomy of Major *rabi* Cereals and Pulses	2		1	3	3	20	50	30	100
#AGR -203	Dryland Farming	2		1	3	3	20	50	30	100
#AGR -204	Cropping Systems and sustainable agriculture	2		1	3	3	20	50	30	100
#AGR -205	Principles and Practices of Organic Farming	2		1	3	3	20	50	30	100
AGR- 206	Seminar I	0		1	1	1	-	-	100	100
**AST -101	Statistical methods for applied sciences	2		1	3	3	20	50	30	100
**ACSS-301	Management of problem soils and water	2		1	3	3	20	50	30	100
***PGS-302	Communicative English and thesis writing	1		1	2	2	20	50	30	100
***PGS-303	Basic Concepts of laboratory techniques	0		2	2	2	-	-	100	100
***PGS-304	Research value and ethics	2		0	2	2	20	80	-	100
##AGR-305	Research: Literature & Review	4				4				100
##AGR-401	Research	16				16				100
AGR -402	Seminar II	0		1	1	1	-	-	100	100
TOTAL THEORY					29	29				**2000**
TOTAL PRACTICAL					18	18				
RESEARCH					20	20				
TOTAL					67	67				

FIRST SEMESTER

COURSE CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				TOTAL CREDITS	MARKS DISTRIBUTION			
		L	T	P	TOTAL		Int Asst.	End Sem	Practical	Total
AGR -101	Modern Concepts in Crop Production	2		1	3	3	20	50	30	100
AGR -102	Principles and Practices of Soil Fertility and Nutrient Management	2		1	3	3	20	50	30	100
AGR -103	Principles and Practices of Weed Management	2		1	3	3	20	50	30	100
AGR -104	Principles and Practices of Water Management	2		1	3	3	20	50	30	100
AGR -105	Agrometeorology and Crop Weather Forecasting	2		1	3	3	20	50	30	100
AGR -106	Agronomy of Major *kharif* Cereals and Pulses	2		1	3	3	20	50	30	100
TOTAL THEORY					**12**	**12**				**600**
TOTAL PRACTICAL					**6**	**6**				
TOTAL					**18**	**18**				

SECOND SEMESTER

COURSE CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				TOTAL CREDITS	MARKS DISTRIBUTION			
		L	T	P	TOTAL		Int Asst.	End Sem	Practical	Total
AGR -201	Agronomy of Oilseed, Fibre and Sugar Crops	2		1	3	3	20	50	30	100
AGR-202	Agronomy of Major *rabi* Cereals and Pulses	2		1	3	3	20	50	30	100
AGR -203	Dryland Farming	2		1	3	3	20	50	30	100
AGR -204	Cropping Systems and sustainable agriculture	2		1	3	3	20	50	30	100
AGR -205	Principles and Practices of Organic Farming	2		1	3	3	20	50	30	100
AGR- 206	Seminar I	0		1	1	1			100	100
TOTAL THEORY					**10**	**10**				**600**
TOTAL PRACTICAL					**6**	**6**				
TOTAL					**16**	**16**				

THIRD SEMESTER

COURSE CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				TOTAL CREDITS	MARKS DISTRIBUTION			
		L	T	P	TOTAL		Int Asst.	End Sem	Practical	Total
AST -101	Statistical methods for applied sciences	2		1	3	3	20	50	30	100
ACSS-301	Management of problem soils and water	2		1	3	3	20	50	30	100
PGS-302	Communicative English and thesis writing	1		1	2	2	20	50	30	100
PGS-303	Basic Concepts of laboratory techniques	0		2	2	2	-	-	100	100
PGS-304	Research value and ethics	2		0	2	2	20	80	-	100
AGR-305	Research: Literature & Review	4				4				100
TOTAL THEORY					**7**	**7**				**600**
TOTAL PRACTICAL					**5**	**5**				
RESEARCH					**4**	**4**				
TOTAL					**16**	**16**				

FOURTH SEMESTER

COURSE CODE	COURSE TITLE	CONDUCT HOURS PER WEEK				TOTAL CREDITS	MARKS DISTRIBUTION			
		L	T	P	TOTAL		Int Asst.	End Sem	Practical	Total
AGR-401	Research		16		**16**	**16**				**100**
AGR -402	Seminar II	0		1	**1**	**1**	-	-	100	**100**
TOTAL					**17**	**17**				**200**

##Research work for master's dissertation: 20

#Major course : 27

*Minor course : 6

**Supporting course : 6

***Compulsory course :6

AGRONOMY
FIRST SEMESTER
Modern Concepts in Crop Production

Code: AGR -101 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To teach the basic concepts of soil management and crop production.

Theory

UNIT I

Crop growth analysis in relation to environment; agro-ecological zones of India.

UNIT II

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.

UNIT III

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

UNIT IV

Scientific principles of crop production; crop response production functions; concept of soil- plant relations; yield and environmental stress.

UNIT V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture, crop residue recycling and management, sustainable agriculture and good agriculture practices.

Suggested Readings

1. Balasubramaniyan P &Palaniappan SP. 2001. *Principles and Practices of Agronomy*.Agrobios.
2. Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
3. Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers.* 7th Ed. Prentice Hall.
4. Paroda R.S. 2003. *Sustaining our Food Security*.Konark Publ.
5. Reddy SR. 2000. *Principles of Crop Production*.Kalyani Publ.
6. Sankaran S &Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing& Publ.
7. Singh SS. 2006. *Principles and Practices of Agronomy*.Kalyani.

Principles and Practices of Soil Fertility and Nutrient Management

Code: AGR -102 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

Theory

UNIT I

Soil fertility and productivity - factors affecting; features of good soil management;problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

UNIT II

Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

UNIT III

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

UNIT IV

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT V

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; Soil amendments in relation to nutrient management -Nutrient management in cropping systems; nutrient management in problem soils , fertilizer use & environmental quality

UNIT VI

Importance of soil micro-organisms in nutrient management; Bio-fertilizers-increasing efficiency - limitations; quality control of fertilizers, organic manures &biofertiliserslegislation

Practical

1. Determination of soil pH, EC, organic C, total N, available N, P, K and S in soils
2. Determination of total N, P, K and S in plants
3. Interpretation of interaction effects and computation of economic and yield optima

Suggested Readings

1. Brady, N. C and Weil, R.R 2002. *The Nature and Properties of Soils* (13th Ed.). Pearson Education.
2. Fageria, N.K., Baligar, V.C. and Jones, C.A. 1991. *Growth and Mineral Nutrition of Field Crops*, Marcel

3. Dekker, New York.
4. Havlin, J.L, Beaton, J.D., Tisdale, S.L. and Nelson, W.L. 2006. *Soil Fertility and Fertilizers* (7th Ed.)Prentice Hall of India, New Delhi.
5. Prasad, R. and Power, J. F. 1997. *Soil Fertility Management for Sustainable Agriculture*.CRC-Lewis, Boca Raton, Florida.
6. Yawalkar, K.S., Agrawal, J.P. and Bokde, S. 2000. *Manures and Fertilizers*.Agri-HortiPubl.

Principles and Practices of Weed Management

Code: AGR -103 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To familiarize the students about the weeds, herbicides and methods of weed control

Theory

UNIT I.

Weed biology and ecology - crop – weed interference – principles of weed management – classification of weed management techniques – weed indices

UNIT II.

Herbicides – introduction – history – classification based on chemical, physiological, methods of application and selectivity– mode and mechanism of action – herbicide selectivity – herbicide antidotes/safeners

UNIT III

Herbicide structure and properties – factors affecting the efficiency of herbicides – herbicide formulations – herbicide mixtures -Degradation of herbicides in soil and plants -Herbicide resistance in weeds and management – weed shift in cropping systems- weed control through bioherbicides and allelochemicals—herbicide resistant crops - herbicide rotation

UNIT IV

Weed management in major crops, cropping systems and non – cropped situations —control of parasitic weeds – control of aquatic and perennial weeds

UNIT – V

Integrated weed management - economics of weed management – new trends in weed management

Practical

1. Identification of important weeds and preparation of herbarium
2. Weed survey in crops and cropping systems
3. Crop - weed competition studies
4. Calibration of sprayers
5. Calculation of herbicide requirements
6. Use of various types of spray pumps and nozzles
7. Preparation of spray solutions and application of herbicides
8. Herbicide residue bioassay
9. Studies on allelopathic influence of various crops and weeds

10. Planning and execution of weed control experiments

Suggested Readings

1. Aldrich, R.J., Kramer, R.J. 1997. *Principles in Weed Management*.Panima publ.
2. Ashton, F.M and Crafts, A.S. 1981. *Mode of Action of Herbicides* (2nd Ed). Wiley inter Science.
3. Gupta,O.P. 2007. *Weed management – Principles and Practices*. Agrobios
4. Mandal, R. C, 1990. *Weed, weedicides and weed control – Principles and Practices*. Agro – Botanical Publ.
5. Rao, V.S. 2000. *Principles of Weed Science.*Oxford & IBH
6. Subramanian, S. Ali, A.M and Kumar, RJ. 1997. *All About Weed Control*. Kalyani
7. Thomas, C.G. and Abraham, C.T. 2007. *Methods in Weed Science.*Kerala Agricultural University, Vellanikkara
8. Zimdahl RL. 1999. *Fundamentals of Weed Science* (2nd Ed). Academic Press

Principles and Practices of Water Management

Code: AGR -104 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To teach the principles of water management and practices to enhance the water productivity.

Theory

UNIT I

Water and its role in plants; Irrigation and irrigation management –definition objectives-limitations-water resources of India and Kerala- Irrigation statistics – present and future expansion or gaps in India and Kerala-major irrigation projects of India and Kerala, extent of area and crops irrigated in India and different states.

UNIT II

Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant /crop response to water stress, crop plant adaptation to moisture stress condition.

UNIT III

Water requirement of crops-Soil, plant and meteorological factors and methods of determining water needs of crops; Irrigation scheduling, depth and methods of irrigation; micro irrigation system; fertigation; management of water in controlled environments and polyhouses. Concepts of – ET, CU, PET, ETc, Epan and their importance in assessing WR. IW/CPE ratio and its importance

UNIT IV

Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; Leaching requirement, irrigation efficiencies and methods of increasing field water use efficiency.

UNIT V

Excess water and plant growth; water management in problem soils; drainage requirement of crops, drainage coefficient and methods of field drainage, their layout and spacing.

Practical

1. Direct and indirect methods of soil moisture determination using tensiometer, and pressure plate and membrane apparatus and resistance blocks
2. Soil-moisture characteristics curves and its importance
3. Water flow measurements using different devices
4. Determination of irrigation requirements of crops
5. Calculation of irrigation efficiency
6. Determination of infiltration rate of soils and hydraulic conductivity
7. Study of micro irrigation systems and their layout in field crops

Suggested Readings

1. Hansen, V.E., Israelsen, O.W., and Stringham, G.E. 1979. *Irrigation Principles andPractices* (4th Ed.). John Wiley and Sons, New York
2. Lenka D.1999. *Irrigation and Drainage*.Kalyani publishing House, Ludhiana. Michael, A.M. 1978. *Irrigation: Theory and Practice*. Vikas Publishing House, New Delhi.
3. Mishra.R.D. andAhamed, M.1993. *Manual of Irrigation Agronomy*. Oxford and IBH Publishing Co., New Delhi
4. Paliwal, K.V. 1972. *Irrigation with Saline Water*. WTC, IARI, New Delhi.
5. Panda, S. C. 2003. *Principles and Practices of Water Management*.Agrobios.
6. Prihar, S. S. and Sandhu.B.S.1987. *Irrigation of Field Crop*s - Principles and practices, ICAR, New Delhi.
7. SankaraReddi, G.H. and Yellamanda Reddy, T. 2003 *Efficient Use of Irrigation Water.*Kalyani , Ludhiana.
8. Singh, P. and Maliwal, P. L. 2005. *Technologies for Food Security and Sustainable Agriculture*.Agrotech Publ.

Agrometeorology and Crop Weather Forecasting

Code: AGR -105 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions.

Theory

UNIT I

Agro meteorology - aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind.

UNIT II

Characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature.

UNIT III

Temperature profile in air, soil, crop canopies; soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapotranspiration and meteorological factors determining evapotranspiration.

UNIT IV

Modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring and planning for mitigation.

UNIT V

Weather forecasting in India – short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture.

Practical

1. Visit to agro-meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure
2. Measurement of solar radiation outside and within plant canopy
3. Measurement/estimation of evapo-transpiration by various methods
4. Measurement/estimation of soil water balance
5. Rainfall variability analysis
6. Determination of heat-unit requirement for different crops
7. Measurement of crop canopy temperature
8. Measurement of soil temperatures at different depths
9. Remote sensing and familiarization with agro-advisory service bulletins
10. Study of synoptic charts and weather reports, working principle of automatic weather station
11. Visit to solar observatory

Suggested Readings

1. Chang Jan Hu ,1968. *Climate and Agriculture on Ecological Survey*. Aldine Publ. Critchfield, H. J.1995. *General Climatology.* Prentice Hall of India.
2. Das, P. K.1968. *The Monsoons*.National Book Trust Publ.

3. Lal, D. S.1998. *Climatology*.ShardaPustakBhawan.
4. Lenka, D.1998. *Climate, Weather and Crops in India*.Kalyani.
5. Mavi, H.S.1994. *Introduction to Agro-meteorology*.Oxford & IBH.
6. Mavi, H. S and Tupper, G. J. 2004. *Agrometeorology: Principles and Application of Climate Studies in Agriculture.* Haworth Press.
7. Menon PA.1991. *Our Weather.*National Book Trust Publ.
8. Sahu, D. D. *Agrometeorology and Remote Sensing: Principles and Practices*. Agrobios.
9. Variraju R and Krishnamurty 1995. *Practical Manual on Agricultural Meteorology*.Kalyani.
10. Varshneya, M.C. and Balakrishana Pillai, P. 2003. *Textbook of Agricultural Meteorology*.ICAR.

Agronomy of Major *kharif* Cereals and Pulses

Code: AGR -106 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To teach the crop husbandry of kharif cereals and pulse crops.

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handlingand processing of theproduce for maximum production**,** value addition and agro-based industries of:

UNIT I

Kharif cereals.

UNIT II

Kharif pulses.

Practical

1. Phenological studies at different growth stages of crop
2. Estimation of crop yield on the basis of yield attributes
3. Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
4. Working out growth indices (CGR, RGR, NAR, LAD), LER, aggressiveness, relative crowding coefficient, monetary yield advantage and ATER (Area Time Equivalent Ratio) of prominent intercropping systems of different crops
5. Estimation of protein content in pulses
6. Planning and layout of field experiments
7. Judging of physiological maturity in different crops
8. Intercultural operations in different crops
9. Determination of cost of cultivation of different crops
10. Working out harvest index of various crops
11. Study of seed production techniques in various crops
12. Visit of field experiments on cultural, fertilizer, weed control and water management aspects
13. Visit to nearby villages for identification of constraints in crop production

Suggested Readings

1. Das, N. R. 2007. *Introduction to Crops of India*.Scientific Publ.
2. Hunsigi, G. and Krishna, K. R. 1998*. Science of Field Crop Production*.Oxford &IBH.
3. Jeswani, L.M. and Baldev, B. 1997. *Advances in Pulse Production Technology*.ICAR.
4. Khare, D. and Bhale, M. S. 2000. *Seed Technology*.Scientific Publ.
5. Kumar Ranjeet and Singh, N. P. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
6. Pal, M., Deka, J. and Rai RK. 1996. *Fundamentals of Cereal Crop Production*. Tata McGraw Hill.
7. Prasad, R. 2002(ed.). *Text Book of Field Crop Production*.ICAR.
8. Singh, C., Singh, P. and Singh, R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
9. Singh, S.S. 1998. *Crop Management*.Kalyani

SECOND SEMESTER

Agronomy of Oil seed, Fibre and Sugar Crops

Code: AGR -201 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To teach the crop husbandry of oilseed, fiber and sugar crops.

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of :

UNIT I

Rabi oilseeds – Rapeseed and mustard, linseed, etc.

UNIT II

Kharif oilseeds - Groundnut, sesame, castor, sunflower, soybean etc.

UNIT III

Fiber crops - Cotton, jute, sunhempetc.

UNIT IV

Sugar crops – Sugar-beet and sugarcane.

Practical

1. Planning and layout of field experiments
2. Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane
3. Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice
4. Phenological studies at different growth stages of crop, visit to a sugarcane research station
5. Intercultural operations in different crops
6. Cotton seed treatment
7. Working out growth indices (CGR, RGR, NAR, LAD), LER, aggressiveness, relative crowding coefficient, monetary yield advantage and ATER (Area Time Equivalent Ratio) of prominent intercropping systems of different crops
8. Judging of physiological maturity in different crops and working out harvest index
9. Working out cost of cultivation of different crops
10. Estimation of crop yield on the basis of yield attributes
11. Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
12. Determination of oil content in oilseeds and computation of oil yield
13. Estimation of quality of fibre of different fibre crops
14. Study of seed production techniques in various crops
15. Visit of field experiments on cultural, fertilizer, weed control and watermanagement aspects
16. Visit to nearby villages for identification of constraints in crop production

Suggested Readings

1. Das, N.R. 2007. *Introduction to Crops of India*.Scientific Publ.
2. Das, P.C. 1997. *Oilseed Crops of India*.Kalyani.
3. Lakshmikantam, N. 1983. *Technology in Sugarcane Growing* (2nd Ed.) Oxford &IBH.
4. Prasad, R. 2002 (ed.). *Text Book of Field Crop Production*.ICAR.
5. Singh ,C, Singh, P. and Singh R. 2003. *Modern Techniques of Raising Field Crops.*Oxford & IBH.
6. Singh, S. S. 1998. *Crop Management*. Kalyani.

Agronomy of Major *rabi* Cereals and Pulses

Code: AGR -202 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To teach the crop husbandry of rabi cereals and pulse crops.

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production**,** value addition and agro-based industries of:

UNIT I

Rabi cereals.

UNIT II

Rabi pulses.

Practical

Phenological studies at different growth stages of crop

Estimation of crop yield on the basis of yield attributes

Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities

Working out growth indices (CGR, RGR, NAR, LAD), LER, aggressiveness, relative crowding coefficient, monetary yield advantage and ATER (Area Time Equivalent Ratio) of prominent intercropping systems of different crops

Estimation of protein content in pulses

Planning and layout of field experiments

Judging of physiological maturity in different crops

Intercultural operations in different crops

Determination of cost of cultivation of different crops

Working out harvest index of various crops

Study of seed production techniques in various crops

Visit of field experiments on cultural, fertilizer, weed control and water management aspects

Visit to nearby villages for identification of constraints in crop production

Suggested Readings

10. Das, N. R. 2007. *Introduction to Crops of India*.Scientific Publ.
11. Hunsigi, G. and Krishna, K. R. 1998. *Science of Field Crop Production*.Oxford &IBH.
12. Jeswani, L.M. and Baldev, B. 1997. *Advances in Pulse Production Technology*.ICAR.
13. Khare, D. and Bhale, M. S. 2000. *Seed Technology*.Scientific Publ.
14. Kumar Ranjeet and Singh, N. P. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
15. Pal, M., Deka, J. and Rai RK. 1996. *Fundamentals of Cereal Crop Production*. Tata McGraw Hill.
16. Prasad, R. 2002(ed.). *Text Book of Field Crop Production*.ICAR.
17. Singh, C., Singh, P. and Singh, R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
18. Singh, S.S. 1998. *Crop Management*.Kalyan

Dryland Farming

Code: AGR -203 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

Theory

UNIT I

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture. Extent of dryland area in India, agencies and programmes of dryland agriculture in India

UNIT II

crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.

UNIT III

Stress physiology and crop resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT IV

Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; types and their mode of action; soil and crop management techniques, seeding and efficient fertilizer use, steps to enhance water use efficiency of dry land crops.

UNIT V

Concept of watershed resource management, problems, approach and components, classification, codification, objectives, strategies, case studies in dry farming situation.

Practical

1. Seed treatment, seed germination and crop establishment in relation to soil moisture contents
2. Moisture stress effects and recovery behaviour of important crops
3. Estimation of moisture index and aridity index
4. Spray of anti-transpirants and their effect on crops
5. Collection and interpretation of data for water balance equations
6. Water use efficiency
7. Preparation of crop plans for different drought conditions
8. Study of field experiments relevant to dryland farming
9. Visit to dryland research stations and watershed projects

Suggested Readings

1. Das, N.R. 2007. *Tillage and Crop Production*.Scientific Publishers.
2. Dhopte. A.M. 2002. *Agro technology for Dry land Farming*.Scientific Publ.
3. DhruvNarayana, V.V. 2002. *Soil and Water Conservation Research in India*.ICAR.
4. Gupta, U.S. (Ed.). 1995. *Production and Improvements of Crops for Drylands*. Oxford & IBH.
5. Katyal, J.C. and Farrington, J. 1995. *Research for Rainfed Farming*.CRIDA.
6. Rao, S.C. and Ryan, J. 2007. *Challenges and Strategies of Dryland Agriculture*.Scientific Publishers.
7. Singh, P. and Maliwal, P.L. 2005. *Technologies for Food Security and Sustainable Agriculture.*Agrotech Publishing Company.
8. Singh, R.P. 1988. *Improved Agronomic Practices for Dryland Crops*.CRIDA.
9. Singh, R.P. 2005. *Sustainable Development of Dryland Agriculture in India*.Scientific Publ.
10. Singh, S.D. 1998. *Arid Land Irrigation and Ecological Management*.Scientific Publishers.
11. Venkateshwarlu, J. 2004. *Rainfed Agriculture in India.Research and Development Scenario*. ICAR

Cropping Systems and sustainable agriculture

Code: AGR -204 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To acquaint the students about prevailing cropping systems in the country and practicesto improve their productivity

Theory

UNIT I

System approach- cropping system, definition and importance-physical resources andits management in cropping systems- Multiple cropping-intercropping, sequential cropping, alley cropping-advantages- interactions in cropping systems- complimentary interactions- competitions-

allelopathic effect-role of non monetary inputs and low cost technologies-input use efficiency in cropping systems

UNIT II

Assessment of yield advantage in intercropping system-assessment of land use- indiceseconomic evaluation of cropping systems- Important cropping systems of India and Kerala-multi storied cropping

UNIT III

Mixed farming-IFS- choice of enterprises- interaction among enterprises-advantages-IFS models for different situations

UNIT IV

Sustainability- concept, scope and objectives- LEIA, LEISA, HEIA -organic farmingcropdiversification for sustainability-role of organic matter in sustainability-crop residue management-sustainable technologies in crop production and management

UNIT V

Plant ideotype for dry lands- plant growth regulators and their role in sustainability

Practical

Sowing and agronomic management of crops under mixed, intercropping and relay systems; Assessment of yield advantages under different cropping systems; Calculation on sustainability/ stability index (relative production efficiency, system water use efficiency, land use efficiency, mandays generation, energy use efficiency, etc.); Evaluation on crop sequences under both irrigated and rainfed conditions; Relay crop production under various cropping systems; Study on scope of multiple cropping under monocropped rainfed situation; Preparation of suitable crop sequences for different agro-climatic zones of West Bengal; Visit of field experiments on mixed, inter, relay and multi-tier cropping in farm/ research station; Visit to nearby village to study on different cropping systems and making a report.

Suggested Readings

1. Gangopadhyay, A. 2007. *Crop Production Systems and Management*. Gene Tech Books
2. Bandopadhyay, A., Sundaram, K. V., Moni, M., Kundu, P.S., Mrityunjay and Jha, M..(eds). 2005. *Sustainable Agriculture-Issues in production, Management , Agronomy and ICT Application*
3. Palaniappan, S.P. and Sivaraman, K. 1996. *Cropping Systems in the Tropics: Principles and Management.*New Age Publishers
4. Panda, S. C. 2003. *Cropping and Farming Systems*.Agrobios
5. Reddy, S. R. 2000. *Principles of Crop Production*.Kalyani
6. Sankaran, S. and Mudaliyar, T.V.S.1997. *Principles of Agronomy*.The Bangalore Printing &Publishing Co.
7. Singh, S. S. 2006. *Principles and Practices of Agronomy*, Kalyani

Principles and Practices of Organic Farming

Code: AGR -205 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

To study the principles and practices of organic farming for sustainable crop production.

Theory

UNIT I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

UNIT III

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

UNIT IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

UNIT V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

1. Aerobic and anaerobic methods of making compost
2. Making of vermicompost
3. Identification and nursery raising of important agro-forestry tress and tress for shelter belts
4. Efficient use of biofertilizers, technique of treating legume seeds withRhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures in field
5. Visit to an organic farm
6. Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

Suggested Readings

1. Ananthakrishnan, T. N. (ed.). 1992. *Emerging Trends in Biological Control of Phytophagousnsects*. Oxford & IBH.
2. Gaur, A.C. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.
3. Lampkin, N. 1990. *Organic Farming*. Press Books, Ipswitch, UK.

4. Palaniappan, S.P and Anandurai, K. 1999. *Organic Farming – Theory and Practice*.Scientific Publ.
5. Soil and climatic parameters with special emphasis on rainfall characteristics;constraints limiting Soil and climatic parameters with special emphasis on rainfall characteristics;constraints limiting
6. Rao, B.V.V. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*: Publ.3, ParisaraprajnaParishtana, Bangalore.
7. Reddy M.V. (ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford &IBH.
8. Sharma, A. 2002. *Hand Book of Organic Farming*. Agrobios.
9. Singh, S. P. (ed.) 1994. *Technology for Production of Natural Enemies.*PDBC, Bangalore.
10. SubbaRao, N.S. 2002. *Soil Microbiology*.Oxford & IBH.
11. Trivedi, R. N.1993. *A Text Book of Environmental Sciences*, Anmol Publ.
12. Veeresh, G. K, Shivashankar, K. and Singlachar, M. A. 1997. *Organic Farming and*
13. *Sustainable Agriculture.* Association for Promotion of Organic Farming, Bangalore.
14. WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*.WHO.
15. Woolmer PL & Swift MJ. 1994. *The Biological Management of Tropical Soil Fertility*. TSBF & Wiley.

SEMINAR I

Code: AGR-206 **Full Marks - 100**

Credit: 1

The seminar paper will be evaluated only by the internal.

THIRD SEMESTER

Statistical methods for applied sciences

Code: AST-101 **Full Marks - 100**

2L+1P=3

Credit-3

Objective

This course is meant for students who do not have sufficient background of Statistical Methods. It would help them in understanding the concepts involved in data presentation, analysis and interpretation and also for taking other supporting courses on Agricultural Statistics. The course is useful to students of all other disciplines especially to students of social sciences

Theory

UNIT I

Classification, tabulation and graphical representation of data.Box-plot, Descriptive statistics.Exploratory data analysis; Theory of probability.Random variable and mathematical expectation.

UNIT II

Discrete and continuous probability distributions: Binomial, Poisson and Normal distribution. Concept of sampling distribution: chi-square, *t* and *F* distributions. Tests of significance based on Normal, chi-square, *t* and *F* distributions. Large sample theory.

UNIT III

Introduction to theory of estimation and confidence-intervals.Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination.Polynomial regression models and their fitting.

UNIT IV

Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks.Kendall's coefficient of concordance.

UNIT V

Introduction to multivariate analytical tools- Classificatory problems and discriminant function, D2-statistic and its applications; Cluster analysis, Principal component analysis and factor analysis

Practical

Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions chi square, t and F; Confidence interval, Interval estimation and point estimation of parameters of Binomial, Poisson and Normal distribution; Correlation and regression analysis, Non parametric tests, Discriminant function analysis, D2 analysis and factor analysis.

Suggested Readings

1. Anderson TW. 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley.
2. Dillon WR & Goldstein M. 1984.*Multivariate Analysis - Methods and Applications*.John Wiley.
3. Goon AM, Gupta MK &Dasgupta B. 1983. *Fundamentals of Statistics*.Vol. I.The World Press.
4. Hoel PG. 1971. *Introduction to Mathematical Statistics*.John Wiley.
5. Hogg RV & Craig TT. 1978. *Introduction to Mathematical Statistics*. Macmillan.
6. Morrison DF. 1976. *Multivariate Statistical Methods*. McGraw Hill.
7. Siegel S, Johan N &Casellan Jr. 1956. *Non-parametric Tests for Behavior Sciences*.John Wiley.
8. Learning Statistics: http://freestatistics.altervista.org/en/learning.php.
9. Electronic Statistics Text Book: http://www.statsoft.com/textbook/stathome.html.

MANAGEMENT OF PROBLEM SOILS AND WATER

Code: ACSS- 301 **Full Marks:100**

2L+1P=3

Credit-3

Theory

UNIT I: Area and distribution of problem soils – acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factors responsible.

UNIT II: Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils - soluble salts, ESP, pH; physical, chemical and microbiological properties.

UNIT III: Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.

UNIT IV: Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

UNIT V: Quality of irrigation water; management of brackish water for irrigation; salt balance under irrigation; characterization of brackish waters, area and extent; relationship in water use and quality.

UNIT VI: Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters.

Practical

• Characterization of acid, acid sulfate, salt-affected and calcareous soils

• Determination of cations (Na+, K+, Ca++ and Mg++) in ground water and soil samples

• Determination of anions (Cl-, SO4--, CO3-- and HCO3-) in ground waters and soil samples

• Lime and gypsum requirements of acid and sodic soils

COMMUNICATIVE ENGLISH AND THESIS WRITING

Code: PGS-302 **Full Marks – 100**

1L+1P=2

Credit-2

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article. Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

BASIC CONCEPTS OF LABORATORY TECHNIQUES

Code:PGS-303 **Full Marks – 100**

0L+2P=2

Credit-2

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

RESEARCH VALUE AND ETHICS

Code:PGS-304 **Full Marks – 100**

2L+0P=2

Credit-2

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility. Research

ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

RESEARCH: LITERATURE AND REVIEW

Code: AGR -305 **Full Marks - 100**

Credit-4

Project work should be defined and related literature review will be done and evaluated

FOURTH SEMESTER

Research

Code: AGR -401 **Full Marks - 100**

Credit-16

Objective

This course is meant for students who want to undertake research work in future and get training through this course. During their M.Sc. dissertation/project work students will be able to know the different aspects of a research work in nutshell. Besides experimental works, learners will learn how to write a M.Sc. thesis starting from introduction (including literature review), objectives of the work through material & methods, results, discussion, conclusion and lastly references.

Seminar II

Code: AGR -402 **Full Marks - 100**

Credit-1

The seminar paper will be evaluated only by the external