Course Title with Credit Load M.Sc. (Ag.) Agronomy

Course Code	Course Title	Credit Hours
Agron 501*	Modern Concepts in Crop Production	3+0
Agron 502*	Principles and Practices of Soil Fertility and Nutrient Management	2+1
Agron 503*	Principles and Practices of Weed Management	2+1
Agron 504*	Principles and Practices of Water Management	2+1
Agron 505	Conservation Agriculture	1+1
Agron 506	Agronomy of Major Cereals and Pulses	2+1
Agron507	Agronomy of Oilseed, Fibre and Sugar Crops	2+1
Agron 508	Agronomy of Medicinal, Aromatic & Underutilized Crops	2+1
Agron 509	Agronomy of Fodder and Forage Crops	2+1
Agron 510	Agrostology and Agro- Forestry	2+1
Agron 511	Cropping System and Sustainable Agriculture	2+0
Agron 512	Dryland Farming and Watershed Management	2+1
Agron 513	Principles and Practices of Organic Farming	2+1
Agron-591	Seminar	(1+0)
Agron-599	Thesis Research	0+30

*Indicates core course which is Compulsory Course

Major courses: From the Discipline in which a student takes admission. Among the 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:

Common Courses: 05 credits

PGS 501	Library and Information Services	0+1
PGS 502	Technical Writing and Communications Skills	0+1
PGS 503	Intellectual Property and its Management in Agriculture	1+0
PGS 504	Basic Concepts in Laboratory Techniques	0+1
PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0

M.Sc. Ag. (Agronomy)
Syllabus Scheme Semester Wise

Semester I

SN	Course Code	Course Title	Credit hours
	Major Compulsory Courses		
1	AGRON-501	Modern Concepts in Crop Production	(3+0) = 3
2	AGRON-503	Principles and Practices of Weed Management	(2+1) = 3
	Major Optional Courses		
1	AGRON-513	Principles and Practices of Organic Farming	(2+1) = 3
2	AGRON-505	Conservation Agriculture	(1+1) = 2
3	AGRON-509	Agronomy of Fodder and Forage Crops	(2+1) = 3
	Note-Student has to select minimum of 02 credits in optional courses from the above list in this semester.		
	#Minor courses		
		Note-Student has to select minimum of 03 credits in minor courses from the below list in this semester.	
	Compulsory Non-Credit Courses (Common Courses)		
1	PGS-501	Library and Information Services	(0+1) = 1
2	PGS-502	Technical Writing and Communications Skills	(0+1) = 1
	Master's Research		
1	AGRON-599	Master's Research	(0+2) = 2
	Total	**9+2+3+2+2 or 9+3+3+2+2**	**18 or 19**

#Minor courses

SN	Course Code	Course Title	Credit hours
1	PL PATH-504 505	Principles of Plant Pathology	(2+1) = 3
2	SOIL-502	Soil Fertility and Fertilizer Use	(2+1) = 3
3	MBB 501	Principles of Biotechnology	(3+0) = 3

Semester II

SN	Course Code	Course Title	Credit hours
	Major Compulsory Courses		
1	AGRON-502	Principles and Practices of Soil Fertility and Nutrient Management	(2+1) = 3
	Major Optional Courses		
1	AGRON-507	Agronomy of Oilseed, Fibre and Sugar Crops	(2+1) = 3
2	AGRON-508	Agronomy of Medicinal, Aromatic & Underutilized Crops	(2+1) = 3
	Note-Student has to select minimum of 03 credits in optional courses from the above list in this semester.		
	#Minor courses		
		Note-Student has to select minimum of 02 credits in minor courses from the above list in this semester.	
	Supporting courses		
1	STAT-511	Experimental Designs	(2+1) = 3
2	Soil-503	Soil Chemistry	(2+1) = 3
3	MBB 503	Molecular Cell Biology	(3+0) = 3
4	MBB 504	Techniques in Molecular Biology I	(3+0) = 3
	Note-Student has to select minimum of 03 credits in supporting courses from the above list in this semester.		
	Compulsory Non-Credit Courses (Common Courses)		
1	PGS-503	Intellectual Property and Its Management in Agriculture	(1+0) = 1
2	PGS-504	Basic Concepts in Laboratory Techniques	(0+1) = 1
	Master's Research		
1	AGRON-599	Master's Research	(0+3) = 3
	Total	**6+2+3+2+3 Or 6+3+3+2+3**	**16 Or 17**

#Minor courses

SN	Course Code	Course Title	Credit hours
1	SOIL-510	Analytical Technique and Instrumental Methods in Soil and Plant Analysis	(0+2) = 2
2	PL PATH-507	Principles of Plant Disease Management	(2+1) = 3
3	MBB 507	Techniques in Molecular Biology II	(0+3) = 3

Semester III

SN	Course Code	Course Title	Credit hours
	Major Compulsory Courses		
1	AGRON-504	Principles and Practices of Water Management	(2+1) = 3
	Major Optional Courses		
1	AGRON-506	Agronomy of Cereals and Pulses	(2+1) = 3
2	AGRON-511	Cropping System and Sustainable Agriculture	(2+1) = 3
3	AGRON-512	Dry land Farming and Watershed Management	(2+1) = 3
	Note-Student has to select minimum of 03 credits in optional courses from the above list in this semester.		
	#Minor courses		
		Note-Student has to select minimum of 03 credits in minor courses from the above list in this semester.	
	Supporting courses		
1	PL PATH-515	Diseases of Field and Medicinal Crops	(2+1) = 3
2	MCA-501	Computers Fundamentals and Programming	(2+1) = 3
3	MBB 515	Environmental Biotechnology	(3+0) = 3
4	MBB 504	Techniques in Molecular Biology I	(3+0) = 3
	Note-Student has to select minimum of three credits in supporting courses from the above list in this semester.		
	Compulsory Non-Credit Courses (Common Courses)		
1	PGS-505	Agricultural Research, Research Ethics and Rural Development Programmes	(1+0) =1
	Master's Seminar		
1	AGRON-591	Master's Seminar	(1+0) = 1
	Master's Research		
1	Agron-599	Master's Research	(0+5) = 5
	Total	**6+3+3+1+1+5**	**19**

#Minor courses

SN	Course Code	Course Title	Credit hours
1	SOIL-504	Soil Mineralogy, Genesis and Classification	(2+1) = 3
3	PL PATH-514	Integrated Disease Management	(2+1) = 3
4	MBB 504	Techniques in Molecular Biology I	(3+0) = 3

Semester IV

SN	Course Code	Course Title	Credit hours
	Master's Research		(0+20) = 20
1	AGRON-599	Master's Research	**20**
	Total	**0+20**	**71 Or 72**
	Grand Total	**21+8+6+5+1+30 Or 21+9+6+5+1+30**	

SCHEME OF EXAMINATION
(Continuous Assessment and End-Semester Examination)

MARKS DISTRIBUTION FOR DIFFERENT CREDIT HOUR COURSES

CREDITS	THEORY			PRACTICALS		
T+P	Total	Mid- Session	End Term	Total	Mid- Session	End Term
1+0	100	40 (30+10#)	60	-	-	-
2+0	100	40 (30+10#)	60	-	-	-
3+0	100	40 (30+10#)	60	-	-	-
4+0	100	40 (30+10#)	60	-	-	-
5+0	100	40 (30+10#)	60	-	-	-
6+0	100	40 (30+10#)	60	-	-	-
0+1	0	0	0	100	50	50
1+1	50	20 (15+5#)	30	50	-	50
2+1	65	25 (20+5#)	40	35	-	35
3+1	75	30 (25+5#)	45	25	-	25
4+1	80	35 (30+5#)	45	20		20
0+2	0	0	0	100	50	50
1+2	35	15 (10+5#)	20	65	-	65
2+2	50	20 (15+5#)	30	50		50
3+2	60	25 (20+5#)	35	40		40
0+3	0	0	0	100	50	50

#Assignments marks

Course Contents
M.Sc. (Ag.) Agronomy

Agron 501
Modern Concepts in Crop Production

Credits: 3 + 0
Contact hours: 42+0

Mid-session exam: 40 (30+10#)
End-semester exam: 60

Aim of the course

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

Theory

Units	Content	Lectures
I	Crop growth analysis in relation to environment; geo-ecological zones of India.	4
II	Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.	8
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.	9
IV	Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress, use of growth hormones and regulators for better adaptation in stressed condition.	9
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. Modern crop production concepts: soil less cultivation, Aeroponic, Hydroponic, Robotic and terrace farming. use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.	12

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome

Basic knowledge on soil management and crop production

Suggested Reading

Balasubramaniyan P and Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.

Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.

Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.

Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.

Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.

Sankaran S and Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.

Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

Alvin PT and kozlowski TT (ed.). 1976. *Ecophysiology of Tropical Crops*. Academia Pul., New York.

Gardner PP, Pearce GR and Mitchell RL. 1985. *Physiology of Crop Plants*. Scientific Pub. Jodhpur.

Lal R. 1989. *Conservation tillage for sustainable agriculture: Tropics versus Temperate Environments. Advances in Agronomy* 42: 85-197.

Wilsie CP. 1961. *Crop Adaptation and Distribution*. Euresia Pub., New Delhi.

Agron 502

Principal and Practices of Soil Fertility and Nutrient Management

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

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

Units	Content	Lectures
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.	6
II	Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.	5
III	Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability andcrop responses; recycling of organic wastes and residue management. Soil lesscultivation.	5
IV	Commercial fertilizers; composition, relative fertilizer value and cost; crop responseto different nutrients, residual effects and fertilizer use efficiency; agronomic, chemical and physiological, fertilizer mixtures and grades; methods of increasing fertilizer use efficiency; nutrient interactions.	6
V	Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic nutrients; economics of fertilizer use; integrated nutrient management; use of vermincompost and residue wastes in crops.	6

Practical

1	Determination of soil pH and soil EC	2
2	Determination of soil organic C	2
3	Determination of available N, P, K and S of soil	3
4	Determination of total N, P, K and S of soil	3
5	Determination of total N, P, K, S in plant	2
6	Computation of optimum and economic yield	2

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome

Basic knowledge on soil fertility and management

Suggested Reading

Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
Fageria NK, Baligar VC and Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
Prasad R and Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
Yawalkar KS, Agrawal JP and Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

Agron 503
Principles and Practices of Weed Management

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

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

Theory

Units	Content	Lectures
I	Weed biology, and ecology and classification, crop-weed competition including allelopathy; principles and methods of weed control and classification management; weed indices, weed shift in different eco-systems	5
II	Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.	5
III	Herbicide structure - activity relationship; factors affecting the efficiency ofherbicides; herbicide formulations, herbicide mixtures, sequential application of herbicides, rotation; weed control through use ofnano-herbicides and bio-herbicides, myco-herbicides bio-agents, and allelochemicals; movement of herbicides in soil and plant, Degradation of herbicides in soil and plants; herbicide resistance, residue, persistence and management; development of herbicide resistance in weeds and crops and their management, herbicide combinationand rotation.	8
IV	Weed management in major crops and cropping systems; alien, invasive and parasitic weeds and their management; weed shifts in cropping systems; aquatic and perennialweed control; weed control in non-crop area.	5
V	Integrated weed management; recent development in weed management-robotics, use of drones and aeroplanes, organic etc., cost: benefit analysis of weed management.	5

Practical

1	Identification of important weeds of different crops, Preparation of a weed herbarium, Weed survey in crops and cropping systems, Crop-weed competition studies, Weed indices calculation and interpretation with data, Preparation of spray solutions of herbicides for high and low-volume sprayers, Use of various types of spray pumps and nozzles and calculation of swath width, Economics of weed control, Herbicide resistance analysis in plant and soil,	8
2	Bioassay of herbicide resistance residues,	3
3	Calculation of herbicidal herbicide requirement	3

Teaching methods/activities

Classroom teaching with AV aids, group discussion, field visit to identify weeds.

Learning outcome

Basic knowledge on weed identification and control for crop production

Suggested Reading

Böger, Peter, Wakabayashi, Ko, Hirai, Kenji (Eds.). 2002. *Herbicide Classes in Development.Mode of Action, Targets, Genetic Engineering, Chemistry*. Springer.

Chauhan B and Mahajan G. 2014. *Recent Advances in Weed Management*. Springer.

Das TK. 2008. *Weed Science: Basics and Applications*, Jain Brothers (New Delhi).

Fennimore, Steven A and Bell, Carl. 2014. *Principles of Weed Control*, 4th Ed, California Weed Sci. Soc.

Gupta OP. 2007. *Weed Management: Principles and Practices*, 2nd Ed.

Jugulan, Mithila (ed). 2017. *Biology, Physiology and Molecular Biology of Weeds*. CRC Press

Monaco TJ, Weller SC and Ashton FM. 2014. *Weed Science Principles and Practices*, Wiley

Powles SB and Shaner DL. 2001. Herbicide Resistance and World Grains, CRC Press.

Walia US. 2006. *Weed Management*, Kalyani.

Zimdahl RL. (ed). 2018. *Integrated Weed Management for Sustainable Agriculture, B. D. Sci. Pub.*

Agron 504
Principles and Practices of Water Management

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam : 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

To teach the principles of water management and practices to enhance the waterproductivity

Theory

Units	Content	Lectures
I	Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in of India and concerned state, major irrigation projects, extent of area and crops irrigated in India and in different states.	3
II	Field water cycle, water movement in soil and plants; transpiration; soil-water- plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Water availability and its relationship with nutrient availability and loses.	3
III	Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and methods of irrigation; micro irrigation systems; deficit irrigation; fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.	3
IV	Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency, Crop water requirement- estimation of ET and effective rainfall; ~~Water management of the major crops and cropping systems~~. Automated irrigation system.	4
V	Excess of soil water and plant growth; ~~water management in problem soils~~, drainagerequirement of crops and methods of field drainage, their layout and spacing; rain water management and its utilization for crop production.	3
VI	~~Quality of irrigation water and management of saline water for irrigation, water management in problem soils~~	3
VII	Soil moisture conservation, water harvesting, ~~rain water management and its utilization for crop production.~~	3
VIII	Hydroponics,	3
IX	Water management of crops under climate change scenario.	3

Practical

1	Determination of Field capacity by field method, Determination of Permanent Wilting Point by sunflower pot culture technique	1
2	Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus	1
3	Determination of Hygroscopic Coefficient, Determination of maximum water holding capacity of soil	1
4	Measurement of matric potential using gauge and mercury type tensiometer	1
5	Determination of soil-moisture characteristics curves	1
6	Determination of saturated hydraulic conductivity by constant and falling headmethod	1
7	Determination of hydraulic conductivity of saturated soil below the water table byauger hole method	1
8	Measurement of soil water diffusivity, Estimation of unsaturated hydraulic conductivity	1
9	Estimation of upward flux of water using tensiometer and from depth ground watertable	1
10	Determination of irrigation requirement of crops (calculations), Determination of effective rainfall (calculations)	1
11	Determination of ET of crops by soil moisture depletion method16. Determinationof water requirements of crops	1
12	Measurement of irrigation water by volume and velocity-area method	1
13	Measurement of irrigation water by measuring devices and calculation of irrigationefficiency	1
14	Determination of infiltration rate by double ring infiltrometer	1

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

Learning outcome

Basic knowledge on water management for optimization of crop yield

Suggested Reading

Majumdar DK. 2014. *Irrigation Water Management: Principles and Practice*. PHL Learning private publishers

Mukund Joshi. 2013. *A Text Book of Irrigation and Water Management Hardcover*, Kalyani publishers

Lenka D. 1999. *Irrigation and Drainage*. Kalyani.

Michael AM. 1978. *Irrigation: Theory and Practice*. Vikas Publ.

Paliwal KV. 1972. *Irrigation with Saline Water*. IARI Monograph, New Delhi.

Panda SC. 2003. *Principles and Practices of Water Management*. Agrobios.

Prihar SS and Sandhu BS. 1987. *Irrigation of Food Crops - Principles and Practices*. ICAR.

Reddy SR. 2000. *Principles of Crop Production*. Kalyani.

Singh Pratap and Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publ.

Agron 505
Conservation Agriculture

Credits: 1 + 1
Contact Hours: 14 + 28

Mid-Session Exam: 20 (15+5#)
Practical Exam: 50
End-Semester Exam: 30

Aim of the course

To impart knowledge of conservation of agriculture for economic development.

Theory

Units	Content	Lectures
I	Conventional and conservation agriculture systems, sustainability concerns, conservation agriculture: Historical background and present concept, global experiences, present status in India.	3
II	Nutrient management in CA, water management, weed management, energy use, insect-pest and disease management, farm machinery, crop residue management, cover crop management.	3
III	Climate change mitigation and CA, C-sequestration, soil health management, soil microbes and CA.	3
IV	CA in agroforestry systems, rainfed / dryland regions	2
V	Economic considerations in CA, adoption and constraints, CA: The future of agriculture	3

Practical

1	Study of long-term experiments on CA,	3
2	Evaluation of soil health parameters,	3
3	Estimation of C-sequestration,	3
4	Machinery calibration for sowing different crops, weed seedbank estimation underCA, energy requirements, economic analysis of CA.	5

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of various types of conservation of agriculture.

Suggested Reading

Arakeri HR and Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford& IBH.
Bisht JK, Meena VS, Mishra PK and Pattanayak A. 2016. Conservation Agriculture-An approach to combat climate change in Indian Himalaya. Publisher: Springer Nature. Doi: 10/1007/978-981-10-2558-7.
Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas. Soils Bull.*, Paper 57.
Gracia-Torres L, Benites J, Martinez-Vilela A and Holgado-Cabera A. 2003. Conservation Agriculture- Environment Farmers eXperiences, innovations Socio-economic policy.
Muhammad F and Kamdambot HMS. 2014. Conservation Agriculture. Publisher: Springer Cham Heidelberg, New Yaork Dordrecht London. Doi: 10.1007/978-3-319-11620-4.
Yellamanda Reddy T and Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani.

Agron 506
Agronomy of Major Cereals and Pulses

Credits: 2 + 1
Contact hours: 28+28

Mid-session exam: 40
End-semester exam: 60

Aim of the course

To impart knowledge of crop husbandry of cereals and pulse crops.

Theory

Units	Content	Lectures
	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 of:	
I	Rabi cereals.	7
II	Kharif cereals.	7
III	Rabi pulses.	7
IV	Kharif pulses.	7

Practical

1	Phenological studies at different growth stages of crop	1
2	Estimation of crop yield on the basis of yield attributes	1
3	Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities	1
4	Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)	1
5	Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)	1
6	Estimation of protein content in pulses	1
7	Planning and layout of field experiments	1
8	Judging of physiological maturity in different crops	1
9	Intercultural operations in different crops	1
10	Determination of cost of cultivation of different crops	1
11	Working out harvest index of various crops	1

		1
12	Study of seed production techniques in selected crops	1
13	Visit of field experiments on cultural, fertilizer, weed control and water management aspects	1
14	Visit to nearby villages for identification of constraints in crop production	1

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome

Basic knowledge on cereals and pulse growing in the country.

Resources

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Hunsigi G and Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.

Jeswani LM and Baldev B. 1997. *Advances in Pulse Production Technology*.ICAR.

Khare D and Bhale MS. 2000. *Seed Technology*. Scientific Publ.

Kumar Ranjeet and Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*.IARI, New Delhi.

Pal M, Deka J and Rai RK. 1996. *Fundamentals of Cereal Crop Production*.Tata McGraw Hill.

Prasad Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P and Singh R. 2003. *Modern Techniques of Raising FieldCrops*. Oxford &IBH.

Singh SS. 1998. *Crop Management*. Kalyani.

Yadav DS. 1992. *Pulse Crops*. Kalyani.

Agron 507
Agronomy of Oilseed, Fibre and Sugar Crops

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam : 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

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

Theory

Units	Content	Lectures
	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:	
I	Rabi oilseeds – Rapeseed and mustard, Linseed and Niger	6
II	Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower	10
III	Fiber crops - Cotton, Jute, Ramie and Mesta.	6
IV	Sugar crops – Sugar-beet and Sugarcane.	6

Practical

1	Planning and layout of field experiments	1
2	Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane	1
3	Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop	1
4	Intercultural operations in different crops, Cotton seed treatment	1
5	Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)	1
6	Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)	1
7	Judging of physiological maturity in different crops and working out harvest index	1
8	Working out cost of cultivation of different crops, Estimation of crop yield on the basis of yield attributes	1
9	Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities	1

10	Determination of oil content in oilseeds and computation of oil yield	1
11	Estimation of quality of fibre of different fibre crops	1
12	Study of seed production techniques in various crops	1
13	Visit of field eXperiments on cultural, fertilizer, weed control and water management aspects	1
14	Visit to nearby villages for identification of constraints in crop production	1

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome

Basic knowledge on production of oil seed, sugar and fibre crops.

Suggested Reading

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
Das PC. 1997. *Oilseed Crops of India*. Kalyani.
Lakshmikantam N. 1983. *Technology in Sugarcane Growing*. 2nd Ed. OXford & IBH.
Prasad Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
Singh C, Singh P and Singh R. 2003. *Modern Techniques of Raising FieldCrops*. OXford &IBH.
Singh SS. 1998. *Crop Management*. Kalyani.

Agron 508

Agronomy of Medicinal, Aromatic and Under Utilized Crops

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

To acquaint students about different medicinal, aromatic and underutilized fieldcrops, their package of practices and processing.

Theory

Units	Content	Lectures
I	Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and their uses, eXport potential and indigenous technical knowledge.	6
II	Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Mulhati, Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, *Stevia*, Safed Musli, Kalmegh, Asaphoetida, *Nuxvomica*, Rosadle, etc).	6
III	Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium).	6
IV	Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco).	5
V	Post harvest handling –drawing, processing, grading, packing and storage, valueaddition and quality standards in herbal products.	5

Practical

1	Identification of crops based on morphological and seed characteristics	3
2	Raising of herbarium of medicinal, aromatic and under-utilized plants	3
3	Quality characters in medicinal and aromatic plants	3
4	Methods of analysis of essential oil and other chemicals of importance in medicinal and aromatic plants.	5

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

Learning outcome

Acquainted with various MAP and their commercial base for developing entrepreneurship.

Suggested Reading

Chadha KL and Gupta R. 1995. *Advances in Horticulture.* Vol. II. *Medicinal and Aromatic Plants.* Malhotra Publ.
Das NR. 2007. *Introduction to Crops of India.* Scientific Publ.
Handa SS. 1984. *Cultivation and Utilization of Medicinal Plants.* RRL, CSIR, Jammu.
Hussain A. 1984. *Essential Oil Plants and their Cultivation.* CIMAP, Lucknow.
Hussain A. 1993. *Medicinal Plants and their Cultivation.* CIMAP, Lucknow.
ICAR 2006. *Hand Book of Agriculture.* ICAR, New Delhi.
Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants.* Oxford & IBH.
Prajapati ND, Purohit SS, Sharma AK and Kumar T. 2003. *A Hand Book of Medicinal Plants: A Complete Source Book.* Agrobios.
Sharma R. 2004. *Agro-Techniques of Medicinal Plants.* Daya Publ. House.

Agron 509
Agronomy of Fodder and Forage Crops

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

To teach the crop husbandry of different forage and fodder crops along with theirprocessing.

Theory

Units	Content	Lectures
I	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like sorghum, maize, *bajra*, *guar*, cowpea, oats, barley, berseem, *senji*, lucerne, etc.	5
II	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasseslime, Napier grass, *Panicum, Lasiuras, Cenchrus,* etc.	5
III	Year-round fodder production and management, preservation and utilization offorage and pasture crops.	5
IV	Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poorquality fodder. Fodder production through hydroponics. Azolla cultivation.	8
V	Economics of forage cultivation uses and seed production techniques of important fodder crops.	5

Practical

1	Practical training of farm operations in raising fodder crops;	3
2	Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose and IVDMD, etc. of various fodder andforage crops	5
3	Anti-quality components like HCN in sorghum and such factors in other crops	3
4	Hay and silage making and economics of their preparation.	3

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

Learning outcome

Acquainted with various fodder and forage crops and their commercial base fordeveloping entrepreneurship.

Suggested Reading

Chatterjee BN. 1989. *Forage Crop Production - Principles and Practices*. Oxford & IBH.
Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Narayanan TR and Dabadghao PM. 1972. *Forage Crops of India*. ICAR.
Singh P and Srivastava AK. 1990. *Forage Production Technology*. IGFRI, Jhansi.
Singh C, Singh P and Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.

Agron 510
Agrostology and Agro-forestry
(To be taught jointly by Agronomy and Forestry)

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam : 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

To teach crop husbandry of different forage, fodder and agroforestry crops/treesalong with their processing.

Theory

Units	Content	Lectures
I	Agrostology: definition and importance; principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological statusof grasslands in India, grass cover of India; problems and management of grasslands.	6
II	Importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.	6
III	Agroforestry: definition and importance; agroforestory systems, agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aquasilviculture, alley cropping and energy plantation.	6
IV	Crop production technology in agro-forestory and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relationto above ground and underground interferences; lopping and coppicing in agro- forestry systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics.	10

Practical

1	Preparation of charts and maps of India showing different types of pastures and agro-forestry systems	2
2	Identification of seeds and plants of common grasses, legumes and trees of economic importance with reference to agro-forestry	2
3	Seed treatment for better germination of farm vegetation	1
4	Methods of propagation/ planting of grasses and trees in silvipastoral system	2
5	Fertilizer application in strip and silvipastroal systems	1
6	After-care of plantation	1
7	Estimation of protein content in loppings of important fodder trees	1
8	Estimation of calorie value of wood of important fuel trees	1

9	Estimation of total biomass and fuel wood	1
10	Economics of agro-forestry	1
11	Visit to important agro-forestry research stations	1

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

Learning outcome

Basic knowledge on agro forestry, forage crops and their utility

Suggested Reading

Chatterjee BN and Das PK. 1989. *Forage Crop Production. Principles and Practices.* OXford & IBH.

Dabadghao PM and Shankaranarayan KA. 1973. *The Grass Cover in India.* ICAR.

Dwivedi AP. 1992. *Agroforestry- Principles and Practices.* OXford & IBH.

Indian Society of Agronomy. 1989. *Agroforestry System in India. Research and Development,* New Delhi.

Narayan TR and Dabadghao PM. 1972. *Forage Crop of India.* ICAR, New Delhi.

Agron 511
Cropping Systems and Sustainable Agriculture

Credits: 2 + 0
Contact hours: 28+0

Mid-session exam: 40 (30+10#)
End-semester exam: 60

Aim of the course

To acquaint the students about prevailing cropping systems in the country andpractices to improve their productivity.

Theory

Units	Content	Lectures
I	Cropping systems: definition, indices and its importance; physical resources, soiland water management in cropping systems; assessment of land use.	4
II	Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.	6
III	Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.	4
IV	Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system. Advanced nutritional tools for big data analysis and interpretation.	6
V	Plant ideotypes for drylands; plant growth regulators and their role in sustainability.	4
VI	Artificial Intelligence- Concept and application.	4

Teaching methods/ activities

Classroom teaching with AV aids, group discussion, assignment.

Learning outcome

Basic knowledge on cropping system for sustainable agriculture.

Suggested Reading

Panda SC. 2017. *Cropping Systems and Sustainable Agriculture*. Agrobios (India)
Panda SC. 2018. *Cropping and Farming Systems*. Agrobios.
Palaniappan SP and Sivaraman K. 1996. *Cropping Systems in the Tropics; Principles and Management*. New Age.
Panda SC. 2003. *Cropping and Farming Systems*. Agrobios.
Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
Sankaran S and Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ. Co.
Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.
Tisdale SL, Nelson WL, Beaton JD and Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice Hall.

Agron 512
Dryland Farming and Watershed Management

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam : 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

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

Theory

Units	Content	Lectures
I	Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.	5
II	Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.	6
III	Stress physiology and 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.	6
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; soil and crop management techniques, seeding and efficient fertilizer use.	8
V	Concept of watershed resource management, problems, approach and components.	3

Practical

1	Method of Seed Priming	1
2	Determination of moisture content of germination of important dryland crops	1
3	Determination of Relative Water Content and Saturation Deficit of Leaf	1
4	Moisture stress effects and recovery behaviour of important crops	1
5	Estimation of Potential ET by Thornthwaite method	1
6	Estimation of Reference ET ny Penman Monteith Method	1
7	Classification of climate by Thornthwaite method (based on moisture index, humidity index and aridity index)	1
8	Classification of climate by Koppen Method	1
9	Estimation of water balance by Thornthwaite method	1

10	Estimation of water balance by FAO method	1
11	Assessment of drought, Water use efficiency	1
12	Estimation of length of growing period, Spray of anti-transpirants and their effect on crops	1
13	Estimation of probability of rain and crop planning for different drought condition	1
14	Visit to dryland research stations and watershed projects	1

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment.

Learning outcome

Basic knowledge on dry land farming and soil moisture conservation.

Suggested Reading

Reddy TY. 2018. Dryland Agriculture Principles and Practices, Kalyani publishers
Das NR. 2007. Tillage and Crop Production. Scientific Publ.
Dhopte AM. 2002. Agrotechnology for Dryland Farming. Scientific Publ.
Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India. ICAR.
Gupta US. (Ed.). 1995. Production and Improvements of Crops forDrylands. OXford & IBH.
Katyal JC and Farrington J. 1995. Research for Rainfed Farming. CRIDA.
Rao SC and Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publ.
Singh P and Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ. Company.
Singh RP. 1988. Improved Agronomic Practices for Dryland Crops. CRIDA.
Singh RP. 2005. Sustainable Development of Dryland Agriculture in India. Scientific Publ.
Singh SD. 1998. Arid Land Irrigation and Ecological Management. Scientific Publ.
Venkateshwarlu J. 2004. Rainfed Agriculture in India. Research and Development Scenario. ICAR.

Agron 513
Principles and Practices of Organic Farming

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam : 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

Aim of the course

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

Theory

Units	Content	Lectures
I	Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organics and farming standards; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.	8
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, bio-fertilizers and biogas technology.	5
III	Farming systems, selection of crops andcrop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.	5
IV	Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.	5
V	Socio-economic impacts; marketing and eXport potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.	5

Practical

1	Method of making compost by aerobic method	1
2	Method of making compost by anaerobic method	1
3	Method of making vermicompost	2
4	Identification and nursery raising of important agro-forestry tress and tress for shelter belts	2
5	Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field	2
6	Visit to a biogas plant	2
7	Visit to an organic farm	2
8	Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms	2

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment. exposure visit

Learning outcome

Basic knowledge on organic farming for sustainable agriculture and development of entrepreneurship on organic inputs.

Suggested Reading

Ananthakrishnan TN. (Ed.). 1992. Emerging Trends in Biological Control of Phytophagous Insects. OXford & IBH.

Gaur AC. 1982. A Manual of Rural Composting, FAO/UNDP Regional Project Document, FAO.

Joshi M. 2016. New Vistas of Organic Farming. Scientific Publishers

Lampin N. 1990. Organic Farming. Press Books, lpswitch, UK.

Palaniappan SP and Anandurai K. 1999. Organic Farming – Theory and Practice. Scientific Publ.

Rao BV Venkata. 1995. Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective: Publ.3, ParisaraprajnaParishtana, Bangalore.

Reddy MV. (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. OXford & IBH.

Sharma A. 2002. Hand Book of Organic Farming. Agrobios.

Singh SP. (Ed.). 1994. Technology for Production of Natural Enemies. PDBC, Bangalore.

Subba Rao NS. 2002. Soil Microbiology. OXford & IBH.

Trivedi RN. 1993. A Text Book of Environmental Sciences, Anmol Publ.

Veeresh GK, Shivashankar K and Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bangalore.

WHO. 1990. Public Health Impact of Pesticides Used in Agriculture. WHO.

Woolmer PL and Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF & Wiley.

PGS 501
LIBRARY AND INFORMATION SERVICES

Credits: 0+1
Contact hours: 28

Mid-session exam : 50
End-semester exam : 50

Objective: To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Sr. No	Practical Description	No. of Practical
1.	Introduction to library and its services; Role of libraries in education, research and technology transfer;	1
2.	Classification systems and organization of library;	3
3.	Sources of information- Primary Sources, Secondary Sources and Tertiary Sources;	1
4.	Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);	2
5.	Tracing information from reference sources;	1
6.	Literature survey; Citation techniques/Preparation of bibliography;	1
7.	Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services;	2
8.	Use of Internet including search engines and its resources; e-resources access methods	3

Suggested Readings

Singh, Ajay Pratap, 2013. Information Communication and Society. New Delhi: EssEss Publishers.
Kumar Krishan, 2013. Reference Service. 5th Rev ed. New Delhi: Vikas.
Dhiman, Anil Kumar, 2005. Information and Reference Sources and Service. New Delhi: EssEss.
Ranganathan, S.R.1989. Reference Service. 2nd Rev. ed. Banglore: Sharda Endowment for Library Science.
Mukjerjee, A.K. 1971. Reference Work and its Tools. 2nd ed. Calcutta: World Press.
Sinha, Pradeep K. 2007. Computer Fundamentals. 4th ed. Delhi: BPB Publications.
#Assignments mark

PGS 502
TECHNICAL WRITING AND COMMUNICATION SKILLS

Credits: 0+1
Contact Hours: 28

Mid-session exam : 50
End-semester exam : 50

Objective: To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Sr. No	Practical Description	No. of Practicals
1.	Technical Writing- Various forms of scientific writings- thesis, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface,.	2
2.	Technical Writing- Introduction, review of literature, material and methods, experimental results and discussion);	2
3.	Technical Writing- Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions;	2
4.	Technical Writing- pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups;	1
5.	Technical Writing- Editing and proof-reading; Writing of a review article.	1
6.	Communication Skills -Grammar (Tenses, parts of speech, clauses, punctuation marks);	1
7.	Communication Skills -Error analysis (Common errors);	1
8.	Communication Skills -Concord; Collocation; Phonetic symbols and transcription;	1
9.	Communication Skills -Accentual pattern: Weak forms in connected speech:	1
10.	Communication Skills -Participation in group discussion: Facing an interview;	1
11.	Communication Skills -presentation of scientific papers.	1

Suggested Readings

Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
James HS. 1994. Handbook for Technical Writing. NTC Business Books.
Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
Mohan K. 2005. Speaking English Effectively. MacMillan India.
Richard WS. 1969. Technical Writing. Barnes & Noble.
Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek. Sethi J &
Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

PGS 503
INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE

Credits: 1 + 0
Contact hours: 14+0

Mid-session exam: 40 (30+10#)
End-semester exam: 60

Objective: The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Units	Contents	Lectures
I	Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement;	3
II	Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and bio-diversity protection	4
III	Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity	4
IV	International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.	3

Suggested Readings

Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.
Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
Rothschild M & Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.
The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000;
Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 504
BASIC CONCEPTS IN LABORATORY TECHNIQUES

Credits: 0+1
Contact hours: 0+28

Mid-session Practical: 50
End-semester Practical: 50

Objective:
To acquaint the students on the basics of commonly used techniques in laboratory.

Practical	Practical Description	No. of Practicals
1.	Safety measures while in Lab; Handling of chemical substances;	1
2.	Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;	1
3.	Washing, drying and sterilization of glassware;	1
4.	Drying of solvents/chemicals.	1
5.	Weighing and preparation of solutions of different strengths and their dilution;	1
6.	Handling techniques of solutions;	1
7.	Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids;	1
8.	Neutralisation of acid and bases;	1
9.	Preparation of buffers of different strengths and pH values.	1
10.	Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;	1
11.	Electric wiring and earthing.	1
12.	Preparation of media and methods of sterilization;	1
13.	Seed viability testing, testing of pollen viability;	1
14.	Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy	1

Reference Books

1. *Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.*
2. *Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.*

PGS 505
AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES

Credits: 1 + 0
Contact hours: 14+0

Mid-session Exam: 40 (30+10#)
End-semester exam: 60

Objective: The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Units	Contents	Lectures
I	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	3
II	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.	3
III	Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics. Concept and connotations of rural development, rural development policies and strategies.	4
IV	Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.	4

Suggested Readings

Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.

Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.

Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.