DAV UNIVERSITY JALANDHAR

FACULTY OF AGRICULTURAL SCIENCES

COURSE CURRICULUM

FOR

M.Sc. Ag. Hort. (Vegetable Science)

1st to 4th SEMESTER

Examinations 2023-2024 session onwards

Applicable for admissions in 2023

Vision of the Department:

Develop human resource to be able to cater to the needs of stakeholders in academia, industry and public/private sector for achieving livelihood security through sustainable agriculture.

Mission of the Department:

- Developing excellence in agriculture education and emerging as leader
- Imparting education to foster inter- disciplinary approach for sustainable agriculture
- Training manpower for upcoming challenges in agriculture with an aim at resource conservation and enhancing farm income

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- PEO1: To encourage students to be creative and innovative to meet the needs of agro based industry by providing a dynamic learning environment
- PEO2: To develop competent human resource in teaching and research in crop production, crop improvement, plant protection and marketing to meet national and global challenges
- PEO3: Developing entrepreneurial skills in students to be 'Job providers rather than Job seekers'
- PEO4: To develop skills of ethical integrity and professional engagement among students to be the voice of farmers and represent them in various national and international forums

PROGRAMME SPECIFIC OUTCOMES

- **PSO1**- Students will learn about advances in different aspects of vegetable science.
- **PSO2**- Students will gain knowledge on various research areas of vegetable science and research methodology.
- **PSO3**- Students obtain practical experience in selection of research area/topic, collection of relevant literature, framing of objectives, selection of material and methods, execution and scientific documentation of research work related to the vegetable crops.

PROGRAMME OUTCOMES

After successful completion of the program, the students will be able to:

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity cantered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Scheme of Courses

M.Sc. Ag. Hort. Vegetable Science

Semester I

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	AGS551	Production Technology of cool season vegetable crops	Core	2	0	2	3
2	AGS552	Breeding of vegetable crops	Core	2	0	2	3
3	AGS553	Growth and development of vegetable crops	Core	2	0	2	3
4	AGS554	Post-Harvest Management of Vegetable Crops	Core	1	0	2	2
5	Open elective or Interdisciplinary elective-I			2	0	2	3
6	CSA559	Computer Fundamentals and Programming	Compulsory Foundation	2	0	2	3

Total=3+3+3+3+3+3=18

L=Lecture; T= tutorial; P=Practical; Cr=Credit

Semester II

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	AGS555	Production Technology of summer season vegetable crops	Core	2	0	2	3
2	AGS556	Seed production technology of vegetable crops	Core	2	0	2	3
4	Departmental elective- II			1	0	2	2
5	Open elective or Interdisciplinary elective-I			2	0	2	3
6	ENG 551	Technical writing and communications skills	Compulsory foundation	0	1	2	1
7	AGS503	Intellectual property and its management in agriculture	Compulsory foundation	1	0	0	1
8	AGS500	Master's Research	Core	0	4	8	4

Total=3+3+2+3+4=17

L=Lecture; T= tutorial; P=Practical; Cr=Credit

Semester II

Departmental elective II

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	AGS557	Fundamentals of processing of vegetables	Elective	1	0	2	2
2	AGS558	Systematics of vegetable crops	Elective	1	0	2	2
3	AGS559	Production technology of underexploited vegetable crops	Elective	1	0	2	2

L=Lecture; T= tutorial; P=Practical; Cr=Credit

Semester III

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	AGS560	Master's Seminar	Core	0	1	2	1
2	MTH 670	Statistical method for applied sciences	Compulsory Foundation	3	0	2	4
3	AGS504	Basic Concepts in Laboratory Techniques	Compulsory Foundation	0	1	2	1
4	AGS505	Agricultural Research, Research Ethics and Rural Development Programmes	Compulsory Foundation	1	0	0	1
5	AGS501	Library and Information Services	Compulsory Foundation	0	1	2	1
6	EVS658	Disaster Management	Compulsory Foundation	1	0	0	1
7	AGS500A	Master's Research	Core	0	6	12	6

Total=1+4+1+1+1+1+6=15

L=Lecture; T= tutorial; P=Practical; Cr=Credit

Semester IV

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	AGS500B	Master's Research	Core	0	15	30	15
2	AGS500C	Thesis work	Core	0	1	4	4

L=Lecture; T= tutorial; P=Practical; Cr=Credit

Departmental Courses

S. No.	Paper code	Title	Type	Credit
1	AGS551	Production Technology of cool season vegetable crops	Core	2+1
2	AGS552	Breeding of vegetable crops	Core	2+1
3	AGS553	Growth and development of vegetable crops	Core	2+1
4	AGS554	Post-harvest management of vegetable crops	Core	2+1
5	AGS555	Production Technology of summer season vegetable crops	Core	2+1
6	AGS556	Seed production technology of vegetable Crops	Core	2+1
7	AGS557	Fundamentals of processing of vegetables	Elective	1+1
8	AGS558	Systematic of vegetable crops	Elective	1+1
9	AGS559	Production technology of underexploited vegetable crops	Elective	1+0
10	AGS560	Seminar	Core	0+1

Outline of the Courses

- **Course 1 (PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS)**

  Objective: To make students aware of all the cultural practices involved in the production technology of winter season vegetables.

  Theory

  Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of:

Course Code	**AGS551**						
Course Title	**Production Technology of cool season vegetable crops**						
Hours	60 L:2, T:0, P:2						
Credits	3						
Type	Core						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** Students learn about various requirements and cultivation practices for Potato and bulb crops (onion and garlic) **CO2:** Students learn about various requirements and cultivation practices for Cole crops **CO3:** Students learn about various requirements and cultivation practices for root crops **CO4:** Students learn about various requirements and cultivation practices for Peas and broad bean, green leafy cool season vegetables						
Examination Type	Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**0**	**25%**	**0**	**35%**	**25%**	**5%**
Syllabus	**Unit 1: (7 hours)** • Potato, Bulb crops: onion and garlic						**CO1**
	Unit 2: (8 hours) • Cole crops: cabbage, cauliflower, knol- kohl, sprouting broccoli, Brussels sprouts						**CO2**

	Unit 3: (7 hours) • Root crops: carrot, radish, turnip and beetroot	**CO3**
	Unit 4: (8 hours) • Peas and broad bean, green leafy cool season vegetables	**CO4**
	Practical (30 hours) Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics; Experiments to demonstrate the role of mineral elements, plant growth substances and herbicides; study of physiological disorders; preparation of cropping scheme for commercial farms; visit to commercial greenhouse/ polyhouse.	

Reference Books:

1. Bose TK & Som MG. (Eds.). 1986. Vegetable Crops in India.
2. Naya Prokash. Bose TK, Som G & Kabir J. (Eds.). 2002. Vegetable Crops. Naya Prokash.
3. Bose TK, Som MG & Kabir J. (Eds.). 1993. Vegetable Crops. Naya Prokash.
4. Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III.
5. Naya Udyog. Chadha KL & Kalloo G. (Eds.). 1993-94. Advances in Horticulture Vols. V-X.
6. Malhotra Publ. House. Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR.
7. Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons. Pandey AK and Mudranalay V. (Eds.). Vegetable Production in India: Important Varieties and Development Techniques.

- **Course 2 (BREEDING OF VEGETABLE CROPS)**

Objective: To make students aware of botany, taxonomy and all the breeding techniques applied for the improvement of important vegetables

Theory

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act for:

Course Code	**AGS552**						
Course Title	**Breeding of Vegetable Crops**						
Hours	60 L:2, T:0, P:2						
Credits	3						
Type	Core						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** Students learn about breeding of Potato, tomato, sweet potato and tapioca, carrot, beetroot and radish **CO2:** Students learn about breeding of Eggplant, hot pepper, sweet pepper and okra **CO3:** Students learn about breeding of Peas and beans, amaranth, chenopods and lettuce **CO4:** Students learn about breeding of Gourds, melons, pumpkins and squashes, Cabbage, cauliflower						
Examination Type	Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	10%	0	25%	0	35%	25%	5%
Syllabus	**Unit 1: (8 hours)** • Potato, tomato, sweet potato and tapioca, carrot, beetroot and radish						**CO1**
	Unit 2: (7 hours) • Eggplant, hot pepper, sweet pepper and okra						**CO2**
	Unit 3: (7 hours) • Peas and beans, amaranth, chenopods and lettuce						**CO3**

	Unit 4: (8 hours) • Gourds, melons, pumpkins and squashes, cabbage and cauliflower	**CO4**
	Practical (30 hours) Selection of desirable plants from breeding population observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations; induction of flowering, paleontological studies, selfing and crossing techniques in vegetable crops; hybrid seed production of vegetable crops in bulk. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops, demonstration of sib-mating and mixed population; molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques. Visit to breeding blocks.	

Suggested Readings

1. Allard RW. 1999. Principles of Plant Breeding. John Wiley & Sons.
2. Basset MJ. (Ed.). 1986. Breeding Vegetable Crops. AVI Publ.
3. Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ. 2005. Plant Genetic Resources: Horticultural Crops. Narosa Publ. House.
4. Fageria MS, Arya PS & Choudhary AK. 2000. Vegetable Crops: Breeding and Seed Production. Vol. I. Kalyani.

- **Course 3 (GROWTH AND DEVELOPMENT OF VEGETABLE CROPS)**

Objective: To make students aware of all the physiological processes involved in the growth and development of important vegetable crops.

Course Code	**AGS553**						
Course Title	**Growth and Development of vegetable crops**						
Hours	60 L:2, T:0, P:2						
Credits	3						
Type	Core						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** Students learn about growth and development, cellular structure, growth analysis and its importance in vegetable production. **CO2:** Students learn about dormancy, germination, role and application of plant hormones in vegetable crops. **CO3:** Students learn about role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production. Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance. Physiology of fruit set, fruit development, fruit growth, flower and fruit drop **CO4:** Students learn about parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening. Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.						
Examination Type	Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	10%	0	25%	0	35%	25%	5%
Syllabus	**Unit 1: (7 hours)** • Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production.						**CO1**

	Unit 2: (7 hours) • Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinin and abscisic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops.	**CO2**
	Unit 3: (8 hours) • Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production. Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance. Physiology of fruit set, fruit development, fruit growth, flower and fruit drop.	**CO3**
	Unit 4: (8 hours) • Parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening. Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.	**CO4**
	Practical (30 hours) Preparation of solutions of plant growth substances and their application; experiments in breaking and induction of dormancy by chemicals; induction of parthenocarpy and fruit ripening; application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables; growth analysis techniques in vegetable crops.	

Suggested Readings

1. Bleasdale JKA. 1984. Plant Physiology in Relation to Horticulture. 2nd Ed. MacMillan.
2. Gupta US. (Ed.). 1978. Crop Physiology. Oxford & IBH.
3. Krishnamoorti HN. 1981. Application Plant Growth Substances and Their Uses in Agriculture. Tata-McGraw Hill

- **Course 4 (Post harvest management of vegetable crops)**

  Objective: To make students aware of classification, origin, evaluation and distribution of important vegetable crops.

<table>
<tr><td>Course Code</td><td colspan="7">AGS554</td></tr>
<tr><td>Course Title</td><td colspan="7">Post-harvest management of vegetable crops</td></tr>
<tr><td>Hours</td><td colspan="7">60 L:2, T:0, P:2</td></tr>
<tr><td>Credits</td><td colspan="7">3</td></tr>
<tr><td>Type</td><td colspan="7">Core</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On the completion of the course, the student will gain the following knowledge and skills:

CO1: Understand the maturity indices, composition and structure, pre-harvest crop management practices and harvesting of vegetables.
CO2: Understand ripening, senescence and storage systems.
CO3: Understand postharvest treatments, packaging, transportation and codex norms.
CO4: Understand the traditional strategies and emerging technologies for post-harvest disease control.</td></tr>
<tr><td>Examination Type</td><td colspan="7">Theory + Practical</td></tr>
<tr><td>Assessment Tools</td><td>Written Quiz</td><td>Assignment/Project Work</td><td>MSE</td><td>MSP</td><td>ESE</td><td>ESP</td><td>ABL/PBL</td></tr>
<tr><td>Weightage</td><td>10%</td><td>0</td><td>25%</td><td>0</td><td>35%</td><td>25%</td><td>5%</td></tr>
<tr><td>Syllabus</td><td colspan="6">Unit 1: (7 hours)
• Maturity indices of horticultural crops, composition and structure of fruits and vegetables and their significance with post-harvest management. Harvesting and its relationship with quality, sorting and grading, pre-harvest crop management practices and their influence on quality during storage and marketing.</td><td>CO1</td></tr>
<tr><td></td><td colspan="6">Unit 2: (8 hours)
• Respiration, ethylene in post-harvest biology, artificial ripening and de-greening of fruits. Physiology of ripening and senescence. Storage system: on-farm storage-evaporatively cooled stores, ventilated storage, pit storage etc. Refrigerated storage refrigeration cycle, controlled/modified atmosphere, hypobaric storage.</td><td>CO2</td></tr>
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	Unit 3: (8 hours) • Application of growth regulators for quality assurance, post-harvest treatments: pre cooling, heat treatments (hot water, hot air and vapor heat), fungicides & biologically safe chemicals, irradiation, curing, pulsing etc. Packing line operations, packaging of horticultural produce. Transportation- rail, road, sea, air. Codex norms for export of perishables.	**CO3**
	Unit 4: (7 hours) • Post-harvest diseases of Hort. Products infection process, factors affecting it; modern methods of controlling decay (use of microbial antagonists their mode of action etc.).	**CO4**
	Practical (30 hours) Morphological features of some selected fruits and vegetables; maturity indices, harvesting techniques of fruits, field visit & identification of spoilage of fruits and vegetables, on-farm storage/ chilling injury, pre-cooling, CA- treatment post-harvest treatments to Hort. produce, pre cooling and storage of fruits and vegetables; studies on pre-treatments of selected fruits; use of chemicals for ripening and enhancing shelf life of fruits and vegetables, various storage systems and structures; prepackaging of fruits; GC for ethylene estimation. Pre-packaging of vegetables; physiological disorders-chilling injury of banana and custard apple, Electrolyte leakage/membrane permeability/ RWC HPLC analysis.	

Suggested Readings

1. Kadar, A.A. 1992. Post-harvest Technology of Horticultural Crops. 2nd Ed. University of California.
2. Salunkhe, D.K., Bolia, H.R. and Reddy, N.R. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.
3. Verma, L.R. and Joshi, V.K. 2000. Post-Harvest Technology of Fruits and Vegetables. Indus Publ.
4. Thompson, A.K. 1995. Post-harvest technology of fruits and vegetables. Blackwell Sciences.
5. Peter, K.V. 2003. Plantation Crops. NBT, New Delhi.

- **Course 5 (Computer Fundamentals and Programming)**

  Objective: To impart knowledge of computers and to develop skills to operate computers, different operating systems.

<table>
<tr><td>Course Code</td><td colspan="7">CSA559</td></tr>
<tr><td>Course Title</td><td colspan="7">Computer Fundamentals and Programming</td></tr>
<tr><td>Hours</td><td colspan="7">60 L:2, T:0, P:2</td></tr>
<tr><td>Credits</td><td colspan="7">3</td></tr>
<tr><td>Type</td><td colspan="7">Compulsory Foundation</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On the completion of the course, the student will gain the following knowledge and skills:

CO1: Understand the computer fundamentals, representation of integers, character representation, ASCII and EBCDIC
CO2: Understand the functional units of computer, I/O devices, primary and secondary memories. Programming fundamentals, Constants and variables; Arithmetic expressions, assignment statement, logical expression.
CO3: Understand the Sequencing, alteration and iteration; Arrays, string processing. Sub-programs, recursion, pointers and files.
CO4: Understand the program correctness; Debugging and testing of programs.</td></tr>
<tr><td>Examination Type</td><td colspan="7">Theory + Practical</td></tr>
<tr><td>Assessment Tools</td><td>Written Quiz</td><td>Assignment/Project Work</td><td>MSE</td><td>MSP</td><td>ESE</td><td>ESP</td><td>ABL/PBL</td></tr>
<tr><td>Weightage</td><td>10%</td><td>0</td><td>25%</td><td>0</td><td>35%</td><td>25%</td><td>5%</td></tr>
<tr><td>Syllabus</td><td colspan="6">Unit 1: (8 hours)
Computer Fundamentals - Number systems: decimal, octal, binary and hexadecimal; Representation of integers, fixed and floating-point numbers, character representation; ASCII, EBCDIC.</td><td>CO1</td></tr>
<tr><td></td><td colspan="6">Unit 2: (8 hours)
Functional units of computer, I/O devices, primary and secondary memories. Programming Fundamentals with C - Algorithm, techniques of problem solving, flowcharting, stepwise refinement; Representation of integer, character, real, data types; Constants and variables; Arithmetic expressions, assignment statement, logical expression.</td><td>CO2</td></tr>
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	Unit 3: (7 hours) Sequencing, alteration and iteration; Arrays, string processing. Sub-programs, recursion, pointers and files.	**CO3**
	Unit 4: (7 hours) Program correctness; Debugging and testing of programs.	**CO4**
	Practical (30 hours) Conversion of different number types; Creation of flow chart, conversion of algorithm/flowchart to program; Mathematical operators, operator precedence; Sequence, control and iteration; Arrays and string processing; Pointers and File processing.	

Suggested Readings

1. Goel, A. (2010). Computer fundamentals, Pearson publishers.
2. Wempen, F. (2015) Computing Fundamentals: Introduction to Computers. John Willey & Sons Inc

- **Course 6 (Production Technology of summer season vegetable crops)**

Objective: To make students aware of all the cultural practices involved in the production technology of summer season vegetables.

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of:

Course Code	**AGS555**						
Course Title	**Production Technology of summer season vegetable crops**						
Hours	56 L:2, T:0, P:2						
Credits	3						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about various requirements and cultivation practices for Solanaceous crops **CO2:** To teach students about various requirements and cultivation practices for Cucurbitaceous crops **CO3:** To teach students about various requirements and cultivation practices for tuber crops **CO4:** To teach students about various requirements and cultivation practices for warm season vegetable crops other than above mention						
Examination Type	Theory/ Practical/ Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**0**	**25%**	**0**	**35%**	**25%**	**5%**
Syllabus	**Unit 1: (7 hours)** • Tomato, eggplant, hot and sweet peppers						**CO1**
	Unit 2: (7 hours) • Okra, beans, cowpea and cluster bean						**CO2**
	Unit 3: (7 hours) • Cucurbitaceous crops						**CO3**

	Unit 4: (7 hours) • Tapioca and sweet potato, Green leafy warm season vegetables	**CO4**
	Practical (28 hours) Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economics; Study of physiological disorders and deficiency of mineral elements, Preparation of cropping schemes for commercial farms; Experiments to demonstrate the role of mineral elements, physiological disorders; plant growth substances and herbicides; Seed extraction techniques; Identification of important pests and diseases and their control; Maturity standards; Economics of warm season vegetable crops	

Reference Books:

1. Bose TK & Som MG. (Eds.). 1986. Vegetable Crops in India. Naya Prokash.
2. Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III. Naya Udyog.
3. Bose TK, Som MG & Kabir J. (Eds.). 2002. Vegetable Crops. Naya Prokash. Brown HD & Hutchison CS. Vegetable Science. JB Lippincott Co.
4. Chadha KL & Kalloo G. (Eds.). 1993-94. Advances in Horticulture. Vols. V-X. Malhotra Publ. House.
5. Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR. Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons.
6. Decoteau DR. 2000. Vegetable Crops. Prentice Hall. Edmond JB, Musser AM & Andrews FS. 1964. Fundamentals of Horticulture. Blakiston Co
7. Fageria MS, Choudhary BR & Dhaka RS. 2000. Vegetable Crops: Production Technology. Vol. II. Kalyani.
8. Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency. Hazra P & Som MG. (Eds.). 1999. Technology for Vegetable Production and Improvement. Naya Prokash.
9. Kalloo G and Singh K (Ed.). 2000. Emerging Scenario in Vegetable Research and Development. Research Periodicals & Book Publ. House.

10. Nayer NM and More TA 1998. Cucurbits. Oxford & IBH Publ.
11. Palaniswamy and Peter KV. 2007. Tuber Crops. New India Publ. Agency.
12. Pandey AK and Mudranalay V. (Eds.). Vegetable Production in India: Important Varieties and Development Techniques.
13. Rana MK. 2008. Olericulture in India. Kalyani.
14. Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani.
15. Rubatzky VE and Yamaguchi M. (Eds.). 1997. World Vegetables: Principles, Production and Nutritive Values. Chapman & Hall.
16. Saini GS. 2001. A Text Book of Oleri and Flori Culture. Aman Publ. House.
17. Salunkhe DK and Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker.
18. Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
19. Singh DK. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co.…

- **Course 7 (Seed production technology of vegetable crops)**

  Objective: To impart knowledge about the protocols of quality seed production of important vegetable crops.

Course Code	**AGS556**						
Course Title	**Seed production technology of vegetable crops**						
Hours	56 L:2, T:0, P:2						
Credits	3						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about scope of vegetable seed production **CO2:** To teach students about different seed agencies, DUS testing and new seed polices **CO3:** To teach students about different methods of hybrid seed production **CO4:** To teach students about different agro-techniques for seed production						
Examination Type	Theory/ Practical/ Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**0**	**25%**	**0**	**35%**	**25%**	**5%**
Syllabus	**Unit 1: (6 hours)** • Definition of seed and its quality • New seed policies • DUS test • Scope of vegetable seed industry in India.						**CO1**
	Unit 2: (6 hours) • Genetical and agronomical principles of seed production • Methods of seed production • Use of growth regulators and chemicals in vegetable seed production • Floral biology, pollination, breeding behavior • Seed development and maturation • Methods of hybrid seed production						**CO2**
	Unit 3: (6 hours) • Categories of seed, Maintenance of nucleus, foundation and certified seed						**CO3**

	• Seed certification, seed standards, seed act and law enforcement • Plant quarantine and quality control	
	Unit 4: (10 hours) • Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology. • Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, cole crops, bulb crops, leafy vegetables, okra, vegetatively propagated vegetables	**CO4**
	Practical (28 hours) Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing; testing, releasing and notification procedures of varieties; floral biology; rouging of off-type; methods of hybrid seed production in important vegetable and spice crops; seed extraction techniques; handling of seed processing and seed testing germination, vigour and health; visit to seed processing units, seed testing laboratory and seed production farms.	

Suggested Readings

1. Agrawal PK & Dadlani M. (Eds.). 1992. Techniques in Seed Science and Technology. South Asian Publ.
2. Agrawal RL. (Ed.). 1997. Seed Technology. Oxford & IBH.
3. Bendell PE. (Ed.). 1998. Seed Science and Technology: Indian Forestry Species. Allied Publ.
4. Fageria MS, Arya PS & Choudhary AK. 2000. Vegetable Crops: Breeding and Seed Production. Vol. I. Kalyani.
5. George RAT. 1999. Vegetable Seed Production. 2nd Ed. CABI.
6. Kumar JC & Dhaliwal MS. 1990. Techniques of Developing Hybrids in Vegetable Crops. Agro Botanical Publ.
7. More TA, Kale PB & Khule BW. 1996. Vegetable Seed production Technology. Maharashtra State Seed Corp.
8. Rajan S & Baby L Markose. 2007. Propagation of Horticultural Crops. New India Publ. Agency.
9. Singh NP, Singh DK, Singh YK & Kumar V. 2006. Vegetable Seed Production Technology. International Book Distributing Co.
10. Singh SP. 2001. Seed Production of Commercial Vegetables. Agrotech Publ. Academy

- **Course 8 (Fundamentals of processing of vegetables)**

  Objective: To teach students about the maturity indices of important vegetable crops and the physiological processes taking place after harvesting and how these physiological processed affects the processing and storage of the produce.

Course Code	**AGS557**						
Course Title	**Fundamentals of processing of vegetables**						
Hours	44 L:1, T:0, P:2						
Credits	3						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about the maturity indices of important vegetable crops **CO2:** To teach students about the physiological processes taking place after harvesting **CO3:** To teach students about Importance of hygiene, Food standards, Food safety **CO4:** To teach students about Utilization of byproducts of vegetable processing industry and management of waste from processing factory						
Examination Type	Theory/ Practical/ Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**0**	**0**	**20%**	**35%**	**30%**	**5%**
Syllabus	**Unit 1: (3 hours)** • History of food preservation • Present status and future prospectus of vegetable preservation industry in India.						**CO1**
	Unit 2: (4 hours) • Spoilage of fresh and processed horticultural produce • Biochemical changes and enzymes associated with spoilage of horticultural produce • Principal spoilage organisms, food poisoning and their control measures. • Role of microorganisms in food preservation						**CO2**

	Unit 3: (4 hours) • Raw materials for processing. Primary and minimal processing; processing equipment. • Layout and establishment of processing industry, FPO license. • Importance of hygiene; Plant sanitation. Quality assurance and quality control, TQM, GMP. • Food standards – FPO, PFA, etc. Food laws and regulations.	**CO3**
	Unit 4: (5 hours) • Food safety – Hazard analysis and critical control points (HACCP). • Labeling and labeling act, nutrition labeling. Major value-added products from vegetables. • Utilization of byproducts of vegetable processing industry • Management of waste from processing factory. Investment analysis. • Principles and methods of sensory evaluation of fresh and processed vegetables	**CO4**
	Practical (28 hours) Study of machinery and equipment used in processing of horticultural produce; Chemical analysis for nutritive value of fresh and processed vegetables; Study of different types of spoilages in fresh as well as processed horticultural produce; Classification and identification of spoilage organisms; Study of biochemical changes and enzymes associated with spoilage; Laboratory examination of vegetable products; Sensory evaluation of fresh and processed vegetables; Study of food standards – National, international, CODEX Alimentarius; Visit to processing Sections to study the layout, equipment, hygiene, sanitation and residual / waste management.	

Suggested Readings

1. Arthey D and Dennis C. 1996. Vegetable Processing. Blackie/Springer- Verlag.
2. Chadha DS. 2006. The Prevention of Food Adulteration Act. Confed. of Indian Industry.
3. Desrosier NW. 1977. Elements and Technology. AVI Publ. Co.

- **Course 9 (Systematics of vegetable crops)**

  Objective: To make students aware of classification, origin, evaluation and distribution of important vegetable crops.

Course Code	**AGS558**						
Course Title	**Systematics of vegetable crops**						
Hours	44 L:1, T:0, P:2						
Credits	3						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables **CO2:** To teach students about cytological level and descriptive keys for important vegetables **CO3:** To teach students about molecular markers as an aid in importance, characterization and taxonomy of vegetable crops. **CO4:** To teach students about Origin, history, evolution and distribution of vegetable crops						
Examination Type	Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**0**	**0**	**20%**	**35%**	**30%**	**5%**
Syllabus	**Unit 1: (4 hours)** • Principles of classification; different methods of classification • Salient features of international code of nomenclature of vegetable crops.						**CO1**
	Unit 2: (5 hours) • Origin, history, evolution and distribution of vegetable crops • Botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables.						**CO2**
	Unit 3: (4 hours)						**CO3**

	• Cytological level of various vegetable crops • Descriptive keys for important vegetables	
	Unit 4: (3 hours) • Importance of molecular markers in evolution of vegetable crops • Molecular markers as an aid in characterization and taxonomy of vegetable crops.	**CO4**
	Practical (28 hours) Identification, description, classification and maintenance of vegetable species and varieties; survey, collection of allied species and genera locally available; preparation of keys to the species and varieties; methods of preparation of herbarium and specimens.	

Suggested Readings

1. Chopra GL. 1968. Angiosperms - Systematics and Life Cycle. S. Nagin Dutta AC. 1986.
A Class Book of Botany. Oxford Univ. Press.
2. Pandey BP. 1999. Taxonomy of Angiosperm. S. Chand & Co.
3. Peter KV & Pradeep Kumar T. 2008. Genetics and Breeding of Vegetables. (Revised), ICAR.
4. Soule J. 1985. Glossary for Horticultural Crops. John Wiley & Sons.
5. Srivastava U, Mahajan RK, Gangopadhyay KK, Singh M & Dhillon BS. 2001. Minimal Descriptors of Agri-Horticultural Crops. Part-II: Vegetable Crops. NBPGR, New Delhi.
6. Vasistha. 1998. Taxonomy of Angiosperm. Kalyani.
7. Vincent ER & Yamaguchi M. 1997. World Vegetables. 2nd Ed. Chapman & Hall.

- **Course 10 (Production technology of underexploited vegetable crops)**

  Objective: To make students aware of all the cultural practices involved in the production technology of underexploited vegetables.

Course Code	**AGS559**						
Course Title	**Production technology of underexploited vegetable crops**						
Hours	44 L:1, T:0, P:2						
Credits	3						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about various requirements and cultivation practices of Asparagus, artichoke and leek etc. **CO2:** To teach students about production technology of Brussels's sprout, Chinese cabbage, broccoli, kale and artichoke etc. **CO3:** To teach students about production technology of yams, beans and gourds etc. **CO4:** To teach students about identification of seeds; botanical description of plants; layout and planting; cultural practices; short-term experiments of underexploited vegetables**.**						
Examination Type	Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**0**	**0**	**20%**	**35%**	**30%**	**5%**
Syllabus	**Unit 1: (3 hours)** • Asparagus, artichoke and leek.						**CO1**
	Unit 2: (4 hours) • Brussels's sprout, Chinese cabbage, broccoli, kale and artichoke						**CO2**
	Unit 3: (5 hours) • Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathu (chenopods) and chekurmanis.						**CO3**
	Unit 4: (8 hours)						**CO4**

	• Elephant foot yam, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean • Sweet gourd, spine gourd, pointed gourd, Oriental pickling melon and little gourd (kundru)	
	Practical (24 hours) Identification of seeds; botanical description of plants; layout and planting; cultural practices; short-term experiments of underexploited vegetables.	

Suggested Readings

1. Bhat KL. 2001. Minor Vegetables - Untapped Potential. Kalyani Publishers.
2. lndira P & Peter KV. 1984. Unexploited Tropical Vegetables. Kerala. Agricultural University, Kerala.
3. Peter KV. (Ed.). 2007-08. Underutilized and Underexploited Horticultural Crops. Vols. IIV. New India Publ. Agency.
4. Rubatzky VE & Yamaguchi M. (Eds.). 1997. World Vegetables: Principles, Production and Nutritive Values. Chapman & Hall
5. Srivastava U, Mahajan RK, Gangopadyay KK, Singh M & Dhillon BS. 2001. Minimal Descriptors of Agri-Horticultural Crops. Part-II: Vegetable Crops. NBPGR, New Delhi.

- **Course 11 (Technical Writing and Communications Skills)**

  Objective: This course is intended to help students in enhancing their technical writing and communication skills.

<table>
<tr><td>Course Code</td><td colspan="7">ENG551</td></tr>
<tr><td>Course Title</td><td colspan="7">Technical Writing and Communications Skills</td></tr>
<tr><td>Hours</td><td colspan="7">48 L:0, T:0, P:2</td></tr>
<tr><td>Credits</td><td colspan="7">1</td></tr>
<tr><td>Type</td><td colspan="7">Multi-Disciplinary Course</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On the completion of the course, the student will gain the following knowledge and skills:

CO1: To teach students about technical writing and various parts of thesis and communication.
CO2: To teach students about writing of abstracts, summaries, précis, citations etc.
CO3: To teach students about writing of a review article. Communication Skills - Grammar
CO4: To teach students about accentual pattern</td></tr>
<tr><td>Examination Type</td><td colspan="7">Practical</td></tr>
<tr><td>Assessment Tools</td><td>Written Quiz</td><td>Assignment/Project Work</td><td>MSE</td><td>MSP</td><td>ESE</td><td>ESP</td><td>ABL/PBL</td></tr>
<tr><td>Weightage</td><td>0</td><td>20%</td><td>0</td><td>30%</td><td>0</td><td>50</td><td>0</td></tr>
<tr><td>Syllabus</td><td colspan="6">Unit 1: (10 hours)
• Technical Writing - 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);</td><td>CO1</td></tr>
<tr><td></td><td colspan="6">Unit 2: (10 hours)
• Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the thesis 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;</td><td>CO2</td></tr>
</table>

	Unit 3: (10 hours) • Writing of a review article. Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription;	**CO3**
	Unit 4: (18 hours) • Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.	**CO4**

Suggested Readings:

1. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
2. Collins' Cobuild English Dictionary. 1995. Harper Collins.
3. Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
4. Gupta RH. 2010. Essentials of Communication. 7th Ed. Pragati Prakashan. Hornby AS. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
5. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
6. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East West Press.
7. Mohan K. 2005. Speaking English Effectively. MacMillan India.
8. Richard WS. 1969. Technical Writing. Barnes & Noble.
9. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
10. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India

- **Course 12 (Intellectual Property and its Management in Agriculture)**

  Objective: To impart knowledge about IPRs and issues related to IPRs

<table>
<tr><td>Course Code</td><td colspan="7">AGS503</td></tr>
<tr><td>Course Title</td><td colspan="7">Intellectual Property and its Management in Agriculture</td></tr>
<tr><td>Hours</td><td colspan="7">12 L:1, T:0, P:0</td></tr>
<tr><td>Credits</td><td colspan="7">1</td></tr>
<tr><td>Type</td><td colspan="7">Multi-Disciplinary Course</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On the completion of the course, the student will gain the following knowledge and skills:

CO1: To teach students about IPR, its types and various provisions in TRIPS
CO2: To teach students about PPV and FR, Protection in biological material and biotechnology
CO3: To teach students about CBD and NBD
CO4: To teach students about ITPGRFR</td></tr>
<tr><td>Examination Type</td><td colspan="7">Theory/ Practical/ Theory + Practical</td></tr>
<tr><td>Assessment Tools</td><td>Written Quiz</td><td>Assignment/Project Work</td><td>MSE</td><td>MSP</td><td>ESE</td><td>ESP</td><td>ABL/PBL</td></tr>
<tr><td>Weightage</td><td>10%</td><td>10%</td><td>25%</td><td>0</td><td>50%</td><td>0</td><td>5%</td></tr>
<tr><td>Syllabus</td><td colspan="6">Unit 1: (3 hours)
• Historical perspectives and need for the introduction of Intellectual Property Right regime
• TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual
• Property Rights (IPR), benefits of securing IPR</td><td>CO1</td></tr>
<tr><td></td><td colspan="6">Unit 2: (3 hours)
• 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.</td><td>CO2</td></tr>
<tr><td></td><td colspan="6">Unit 3: (3 hours)
• Protection of plant varieties and farmers’ rights and biodiversity protection; Protectable subject matters,</td><td>CO3</td></tr>
</table>

	protection in biotechnology, protection of other biological materials, ownership and period of protection	
	Unit 4: (3 hours) • National Biodiversity protection initiatives; Convention on Biological Diversity • International Treaty on Plant Genetic Resources for Food and Agriculture • Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement	**CO4**

Suggested Readings

1. Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw Hi

- **Course 13 (Basic Concepts in Laboratory Techniques)**

Objective: To provide practical skill to the students to handle and use various laboratory equipment's.

Course Code	**AGS504**						
Course Title	**Basic Concepts in Laboratory Techniques**						
Hours	24 L:0, T:1, P:2						
Credits	2						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about safety measures in lab, handing of chemical substances **CO2:** To teach students about handling, weighing and preparation of solution **CO3:** To teach students about use and handling of lab equipment **CO4:** To teach students about preparation of media and methods of sterilization, seed viability testing						
Examination Type	Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**0**	**20%**	**0**	**30%**	**0**	**50%**	**0**
Syllabus	**Unit 1: (6 hours)** • Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes, washing, drying and sterilization of glassware.						**CO1**
	Unit 2: (6 hours) • 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						**CO2**
	Unit 3: (6 hours)						**CO3**

	• Preparation of solutions of acids; Neutralization 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, sand bath, water bath, oil bath; Electric wiring and earthing.	
	Unit 4: (6 hours) • 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	**CO4**

Suggested Readings

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

- **Course 14 (Agricultural Research, Research Ethics and Rural Development Programmes)**

Objective: To acquaint students about Agriculture Research Systems globally, research ethics and about various rural development programmes.

Course Code	**AGS505**						
Course Title	**Agricultural Research, Research Ethics and Rural Development Programmes**						
Hours	12 L:1, T:0, P:0						
Credits	1						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To teach students about NARS, CGIAR and IARC **CO2:** To teach students about role in promoting food security, reducing poverty and protecting the environment **CO3:** To teach students about concept and connotations of rural development, rural development policies and strategies **CO4:** To teach students about critical evaluation of rural development policies and programmes						
Examination Type	Theory/ Practical/ Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**10%**	**25%**	**0**	**50%**	**0**	**5%**
Syllabus	**Unit 1: (3 hours)** • History of agriculture in brief; Global agricultural research system: need, scope, opportunities, Sectionals; 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)						**CO1**
	Unit 2: (3 hours) • 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						**CO2**

	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.	
	Unit 3: (3 hours) • Concept and connotations of rural development, rural development policies and strategies, Rural Development Programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP)	**CO3**
	Unit 4: (3 hours) • Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation ofrural policies and programmes.	**CO4**

Suggested Readings

1. Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ

- **Course 15 (Library and Information Services)**

Objective: This course is intended to equip students with skills to use different e-resources to get information.

Course Code	**AGS501**						
Course Title	**Library and Information Services**						
Hours	24 L:0, T:1, P:2						
Credits	1						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To study about library, its role, classification and organization. **CO2:** To study about source of information, intricacies of abstracting and indexing services **CO3:** To study about tracing information from reference sources **CO4:** To study about use of Internet including search engines and its resources; e-resources access methods						
Examination Type	Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**0**	**20%**	**0**	**30%**	**0**	**50%**	**0**
Syllabus	**Unit 1: (4 hours)** • Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library						**CO1**
	Unit 2: (6 hours) • Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.)						**CO2**
	Unit 3: (8 hours) • Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online						**CO3**

	Public Access Catalogue and other computerized library services	
	Unit 4: (6 hours) • Use of Internet including search engines and its resources; e-resources access methods.	**CO4**

Suggested Readings:

1. Wu Diana Yuhfen and Liu Mengxiong. 2001. Academic librarianship: changing roles in the digital age. Available at http//www.sssu.edu/ridwu/academic librarianship P&F. Accessed March 10, 2008
2. Library.2004. Encyclopedia Britannica premium service http//www.britannica.com/eb/ article eu=09616. Accessed March 10, 2008
3. Young, P.V. (1984). Scientific social survey and research. Rev. 4th Ed. Prentice Hall, New Delhi.
4. https://guides.library.manoa.hawaii.edu/PlantPath/Books
5. https://unl.libguides.com/c.php?g=51695&p=334113
6. https://libraries.unl.edu/citation-tools

- **Course 16 (Disaster Management)**

Objective: To impart knowledge about various calamities and their management at national and international level and role of different organizations in disaster management.

Course Code	**EVS658**						
Course Title	**Disaster Management**						
Hours	12 L:1, T:0, P:0						
Credits	1						
Type	**Multi-Disciplinary Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** To study about natural disasters, floods and drought etc and global warming **CO2:** To teach students about man-made disasters, different type of pollution **CO3:** To teach students about disaster management **CO4:** To teach students about Community-based organizations and armed forces in Disaster response						
Examination Type	Theory/ Practical/ Theory + Practical						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ABL/PBL
Weightage	**10%**	**10%**	**25%**	**0**	**50%**	**0**	**5%**
Syllabus	**Unit 1: (3 hours)** • Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.						**CO1**
	Unit 2: (3 hours) • Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents						**CO2**
	Unit 3: (3 hours)						**CO3**

	• Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs	
	Unit 4: (3 hours) • Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations	**CO4**

Suggested Readings

1. Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
2. Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe: A Handbook of Disaster Management. Routledge.
3. Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

- **Course 17 (Statistical Methods for Applied Sciences)**

  Objective: It would help students in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure of data presentation, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

<table>
<tr><td>Course Code</td><td colspan="7">MTH670</td></tr>
<tr><td>Course Title</td><td colspan="7">Statistical Methods for Applied Sciences</td></tr>
<tr><td>Hours</td><td colspan="7">60 L:3, T:0, P:1</td></tr>
<tr><td>Credits</td><td colspan="7">4</td></tr>
<tr><td>Type</td><td colspan="7">Multi-Disciplinary Course</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On the completion of the course, the student will gain the following knowledge and skills:

CO1: To teach students about different statistical methods and classifications
CO2: To teach students about measures of central tendency and measure of dispersion
CO3: To teach students about theory of probability
CO4: To teach students about different distributions, their applications and statistical tests</td></tr>
<tr><td>Examination Type</td><td colspan="7">Theory + Practical</td></tr>
<tr><td>Assessment Tools</td><td>Written Quiz</td><td>Assignment/Project Work</td><td>MSE</td><td>MSP</td><td>ESE</td><td>ESP</td><td>ABL/PBL</td></tr>
<tr><td>Weightage</td><td>10%</td><td>0</td><td>25%</td><td>0</td><td>35%</td><td>25%</td><td>5%</td></tr>
<tr><td>Syllabus</td><td colspan="6">Unit 1: (9 hours)
• Classification, tabulation and graphical, representation of data.
• Box-plot, Descriptive statistics. Exploratory data analysis</td><td>CO1</td></tr>
<tr><td></td><td colspan="6">Unit 2: (9 hours)
• Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean.
• Measures of Dispersion- Range, Quartile deviation, Mean deviation, Standard deviation</td><td>CO2</td></tr>
<tr><td></td><td colspan="6">Unit 3: (9 hours)</td><td>CO3</td></tr>
</table>

	• Theory of probability. Random variable and mathematical expectation. • Discrete and continuous probability distributions. Correlation and regression	
	Unit 4: (9 hours) • Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. • Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.	**CO4**
	Practical (24 hours) Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions-chi square, t and F; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Nonparametric tests.	

Suggested Readings

1. Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
2. Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I
3. Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I.
4. Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.