

POST GRADUATE DEPARTMENT OF AGRICULTURE

SYLLABUS FOR THE BATCH FROM THE YEAR 2022 TO YEAR 2024

Programme Code : MHFS

**Programme Name : M.Sc. Ag. Horticulture
(Fruit Science)**

(Semester I –IV)

Examinations: 2023-24



Khalsa College Amritsar

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(b) Subject to change in the syllabi at any time.
(c) Please visit the college website time to time**

Programme Objectives:-

1. To train and develop scholars and promote research by providing students with contemporary concepts in various fields of crop Horticulture.
2. To generate knowledge through cognitive, affective and psychomotor which are necessary for productive scholarly research in the specific field of fruit science.
3. To acquire in depth knowledge in areas of specialization.
4. The program will contribute to the development of agriculture sector and thereby ensure food security and self sufficiency.

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| M.Sc. Ag.(Horticulture- Fruit Science) Programme Specific Outcomes(PSOs) and Course Outcomes(Cos) |
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PROGRAMME SPECIFIC OUTCOMES

| | |
|---------------|---|
| PSO-1 | To evolve into postgraduates with knowledge and understanding of concepts across diverse areas in Horticulture.. |
| PSO-2 | To serve as skilled human resource tailored to formulate, analyse, and resolve complex problems in horticultural crops.. |
| PSO-3 | To apply the knowledge and skills acquired to cater the needs of the industry, academia, research and the society for contributing to nation-building |
| PSO-4 | To provide and promote consultancy services in the fields of Horticultural research, training and dissemination of information and technology |
| PSO-5 | To utilize the opportunities present in the market for the upliftment of society. |
| PSO-6. | To cater the needs of line departments and horticulture based industries through the acquired knowledge in horticulture |
| PSO-7 | To develop into an entrepreneur by harnessing the acquired knowledge and skills of horticulture |
| PSO-8 | To emerge as an ambassador of horticulture through the service rendered to the farming community. |

SEMESTER-I

| Course Code | Course Title | Credit Hours | Marks | Total Marks | Page Number |
|--------------------------------|---|-------------------|----------------------------------|-------------|-------------|
| | | | Theory +Practical +I. Assessment | | |
| FSC-511 | Tropical Fruit Production and Dry Land Horticulture | 3(2+1) | 50+25+25 | 100 | 6-7 |
| FSC-512 | Nutrient and Canopy Management in Fruit Crops | 3(2+1) | 50+25+25 | 100 | 8 |
| PBG-513/ BCH-513 (Minor) | Principles of Plant Breeding/ Fundamentals of Biochemistry | 3(2+1) | 50+25+25 | 100 | 9-11 |
| STA-414 | Statistical Methods for Research Workers | 3(2+1) | 50+25+25 | 100 | 12 |
| *PGS-501 | Technical Writing & Communication Skills | 1(1+0) | 100 (Th) | 100 | 13 |
| *PGS-502 | Library & Information Services | 1(0+1) | 100 (Pr) | 100 | 14 |
| *FSC-600 | Masters' Research | 4(0+4) | - | S/US | 15 |
| | Total | 18 (12+6*) | | | |

* Non - credit course

Total Internal Assessment = 25 marks (House Test –10 marks ; Attendance – 10 marks; Conduct &Academic, Extra Curricular Activities – 5 marks).

SEMESTER-II

| Course Code | Course Title | Credit Hours | Marks | Total Marks | Page Number |
|--------------------------------|--|--------------------|------------------------------------|-------------|-------------|
| | | | Theory+Practical+ I. Assessment | | |
| FSC-521 | Sub Tropical and Temperate Fruit Production | 3(2+1) | 50+25+25 | 100 | 16-17 |
| FSC-522 | Breeding of Fruit Crops | 3(2+1) | 50+25+25 | 100 | 18 |
| PBG-523/ BCH-523 (Minor) | Breeding for Biotic and Abiotic Stress Resistance/ Experiments in Biochemistry | 3(2+1) | 50+25+25 | 100 | 19-21 |
| STA-524 | Experimental Designs for Research Workers | 3(2+1) | 50+25+25 | 100 | 26-27 |
| *PGS-503 | Agricultural Research & Publication Ethics | 1(1+0) | 100(Th) | 100 | 28 |
| *FSC-600 | Masters' Research | 4(0+4) | -- | S/US | 29 |
| | Total | 17 (12+5*) | | | |

* Non - credit course

Total Internal Assessment = 25 marks (House Test –10 marks ; Attendance – 10 marks; Conduct & Academic, Extra Curricular Activities – 5 marks).

SEMESTER-III

| Course Code | Course Title | Credit Hours | Marks | Total Marks | Page Number |
|--------------------------------|--|-------------------|------------------------------------|-------------|-------------|
| | | | Theory + Practical + I. Assessment | | |
| FSC-531 | Principles and Practices of Plant Propagation | 3(2+1) | 50+25+25 | 100 | 30-31 |
| FSC-532 | Plant Growth Regulators in Fruit Crops | 3(2+1) | 50+25+25 | 100 | 32 |
| PBG-531/ BCH-531 (Minor) | Maintenance Breeding and Concepts of Variety Release and Seed Production /Fundamentals of Nutritional Biochemistry | 3(2+1) | 50+25+25 | 100 | 33-34 |
| FSC-591 | Credit seminar | 1(1+0) | 100 | 100 | 35 |
| *PGS-504 | Intellectual Property & its management in Agriculture | 1(1+0) | 100 (Th) | 100 | 36 |
| *FSC-600 | Masters' Research | 6(0+6) | - | S/US | 37 |
| | Total | 17 (10+7*) | | | |

* Non - credit course

Total Internal Assessment = 25 marks (House Test –10 marks ; Attendance – 10 marks; Conduct & Academic, Extra Curricular Activities – 5 marks).

SEMESTER-IV

| Course Code | Course Title | Credit Hours | Marks | Total Marks | Page Number |
|-------------|--|------------------|----------------------------------|-------------|-------------|
| | | | Theory +Practical +I. Assessment | | |
| FSC-541 | Citriculture | 3(2+1) | 50+25+25 | 100 | 38-39 |
| FSC-542 | Orchard Floor Management and Organic Agriculture | 3(2+1) | 50+25+25 | 100 | 40-41 |
| *PGS-505 | Disaster Management | 1(1+0) | 100 (Th) | 100 | 42 |
| *FSC-600 | Masters' Research | 6(0+6) | - | S/US | 43 |
| | Total | 13 (6+7*) | | | |

* Non - credit course

Total Internal Assessment = 25 marks (House Test –10 marks ; Attendance – 10 marks; Conduct &Academic, Extra Curricular Activities – 5 marks).

SEMESTER-I

FSC-511: Tropical Fruit Production and Dry Land Horticulture

Maximum marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours : 3 (2+1)

Time: 3 Hours

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objective

- To impart comprehensive knowledge to the students on cultural and management practices for growing tropical fruits.

Theory

Origin, Distribution, Commercial Importance and Export Potential. Eco physiological Requirements. Species and Varieties. Rootstocks and Propagation. Planting, Root Zone, Training and Pruning. Nutrition and Water Requirements, Fertigation, Role of Bio-regulators, Major Pests, Diseases, Physiological Disorders and their Control Measures. Abiotic Factors limiting Fruit Production. Flowering, Pollination and Fruit set. Quality improvement Storage and Ripening Techniques. Industrial and Export potential, Agri. Export Zones (AEZ) and Industrial Support. Fruit Crops-

Section-A: Citrus, Mango, Papaya, Pineapple, Banana,

Section-B: Avocado, Sapota, Guava, Ber, Pomegranate,

Section-C: Aonla, Jack Fruit, Annonas, Minor Fruits of Tropics.

Section-D: Possibilities and Constraints in Dry Land Fruit Production Fruits suitable for Dry Land Horticulture.

Practical

Description and Identification of Species and Varieties. Growth and Development. Growth Regulation. Nutritional and Physiological Disorders and their Control. Rejuvenation of Old and Unproductive Trees. Visit to Commercial Orchards. Project Preparation for Establishing Commercial Orchards.

Suggested Reading

- Bartholomew DP, Paull RE and Rohrbach KG. 2002. The Pineapple: Botany, Production, and Uses. CAB International.

- Bose TK, Mitra SK and Sanyal D. 2002. Fruits of India – Tropical and Sub-Tropical.3rd Edn. Naya Udyog, Kolkata.
- Dhillon WS. 2013. Fruit Production in India. Narendra Publ. House, New Delhi.
- Iyer CPA and Kurian RM. 2006. High Density Planting in Tropical Fruits: Principles and Practices. IBDC Publishers, New Delhi.
- Litz RE. 2009. The Mango: Botany, Production and Uses. CAB International.
- Mitra SK and Sanyal D. 2013. Guava, ICAR, New Delhi.
- Morton JF. 2013. Fruits of Warm Climates. Echo Point Book Media, USA.
- Nakasome HY and Paull RE. 1998. Tropical Fruits. CAB International.
- Paull RE and Duarte O. 2011. Tropical Fruits (Vol. 1). CAB International.
- Rani S, Sharma A and Wali VK. 2018. Guava (Psidium guajava L.). Astral, New Delhi.
- Robinson JC and Saúco VG. 2010. Bananas and Plantains. CAB International.
- Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.
- Schaffer B, Wolsten holme BN and Whiley AW. 2013. The Avocado: Botany, Production and Uses. CAB International.
- Sharma KK and Singh NP. 2011. Soil and Orchard Management. Daya Publishing House, New Delhi.
- Valavi SG, Peter KV and Thottappilly G. 2011. The Jackfruit. Stadium Press, USA

Course Title : Tropical Fruit Production and Dry Land Horticulture
Course Code : FSC-511

| Sr.no. | On completing the course, the students will be able to |
|--------|---|
| CO1 | Equip themselves with know-how on agro-techniques for establishment and management of an orchard leading to optimum and quality fruit production of tropical fruits |

SEMESTER-I

FSC-512

Nutrient and Canopy Management in Fruit Crops

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objective

- To impart knowledge on principles and practices in management of canopy architecture for quality fruit production

Theory

Section-A: Essential elements, Criteria of essentiality. Natural sources and fertilizers. Role of essential elements in fruit plants. Interaction of nutrients.

Section-B: Canopy management, Importance and advantages. Factors affecting canopy development. Canopy types and structures.

Section-C: Light interception and distribution in different types of tree canopies. Spacing and utilization of land area. Canopy management through the use of rootstock and scion, plant growth inhibitors, training and pruning and management practices.

Section-D: Canopy development in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, pomegranate, mango, sapota, guava, citrus and ber.

Practical:

Leaf sampling techniques, Determination of nutrient status through soil and plant analysis. Study of different types of canopies. Training of plants for different canopy types. Canopy development through pruning, use of plant growth inhibitors and, geometry of planting. Effect of canopy types on production and quality of fruits.

Suggested Reading

- Bakshi JC, Uppal DK and Khajuria HN. 1988. The Pruning of Fruit Trees and Vines.

Kalyani Publishers, New Delhi.

- Chadha KL and Shikhamany SD. 1999. The Grape, Improvement, Production and Post Harvest Management. Malhotra Publishing House, Delhi.
- Iyer CPA and Kurian RM. 2006. High Density Planting in Tropical Fruits: Principles and Practices. IBDC Publishers, New Delhi.
- Pradeep kumar T. 2008. Management of Horticultural Crops. NIPA, New Delhi.
- Singh G. 2010. Practical Manual on Canopy Management in Fruit Crops. Dept. of Agriculture and Co-operation, Ministry of Agriculture (GoI), New Delhi.
- Srivastava KK. 2012. Canopy Management in Fruits. ICAR, New Delhi.

Course Title : Nutrient and Canopy Management in Fruit Crops Course Code : FSC-512

| Sr.no. | On completing the course, the students will be able to |
|---------------|--|
| CO1 | The basic principles of canopy management to modify plant architecture |
| CO2 | The skills on training and pruning of fruit crops, and growth regulation |

SEMESTER-I

PBG-513

Principles of Plant Breeding (Minor)

Time: 3 Hours

Maximum marks: 100
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours:3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objective

- To impart theoretical knowledge and practical skills about plant breeding objectives, genetic consequences, breeding methods for crop improvement

Theory:

Section-A: History of Plant Breeding, objectives and achievements. Centres of origin, biodiversity and its significance. Plant introduction and role of plant genetic resources in plant breeding.

Section-B: Genetic basis of breeding self- and cross-pollinated crops, Mating systems and response to selection. Pure line theory. Breeding methods in self-, cross-pollinated and asexually reproducing crops. Heterosis and inbreeding.

Section-C: Concept of plant ideotype. Transgressive breeding. Hybrid breeding. Self-incompatibility and male sterility in crop plants and their commercial exploitation. Mutation breeding.

Section-D: Breeding for abiotic and biotic stresses. Testing, release and notification of varieties. Maintenance breeding. Participatory Plant Breeding. Plant Breeders' Rights and regulations for plant variety protection and farmers' rights.

Practical:

Floral biology of self- and cross-pollinated species. Selfing and crossing techniques. Selection methods in segregating populations and evaluation of breeding material. Maintenance of

experimental records. Estimation of heterosis and inbreeding depression. Techniques in hybrid seed production using male-sterility in field crops.

Suggested Reading

- Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
- Chahal GS and Gossal, SS. 2002. Principles and Procedures of Plant Breeding Biotechnological and Conventional approaches. Narosa Publishing House.
- Chopra VL. 2004. Plant Breeding. Oxford & IBH.
- George A. 2012. Principles of Plant Genetics and Breeding. John Wiley & Sons.
- Gupta SK. 2005. Practical Plant Breeding. Agribios.
- Jain HK and Kharakwal MC. 2004. Plant Breeding and–Mendelian to Molecular Approach, Narosa Publications, New Delhi
- Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ. House.
- Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
- Sharma JP. 2010. Principles of Vegetable Breeding. Kalyani Publ, New Delhi.
- Simmonds NW.1990. Principles of Crop Improvement. English Language Book Society.
- Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.
- Singh S and Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS

Course Title : Principles of Plant Breeding (Minor)

Course Code : PBG-513

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Know breeding methods, different hybridization techniques for genomic reshuffling. |
| CO2 | Acquaint with importance of floral biology, mutation breeding and participatory plant breeding, etc |

SEMESTER-I

BCH-513

Fundamentals of Biochemistry (Minor)

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks(Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives

- The course is designed to give students basic concepts of biochemistry and its nature of interdisciplinary importance.
- To let students understand the physical and chemical properties of molecules, and their status of occurrence in biological system.

Theory:

Section-A: Cell structure and function. Structure and role of water in biological system. Acids, bases and buffers of living systems.

Section-B: The pK of biomolecules. Classification of enzymes. Effect of substrate, temperature, pH, activators and inhibitors on enzyme catalysis. Vitamins and hormones.

Section-C: Bio-membranes structure and function. Bioenergetics and oxidative phosphorylation. Metabolism of carbohydrates, lipids, proteins, nucleic acids. Photosynthesis and respiration.

Section-D: DNA replication, transcription and translation. Regulation of transcription. Recombinant DNA technology. Secondary plant products.

Practical:

Study of cell structure and its functions. Preparation of buffer solutions. Calculation of pH. Study of enzymes. Enzyme extraction. Study of vitamins and hormones. Extraction of carbohydrates, lipids and proteins. Study of DNA and its structure.

Suggested Reading

- Biochemistry” (2019) J.M. Berg, J.L. Tymoczko, G.J. Gatto and L. Stryer, pub. W.H. Freeman.
- Biochemistry” (2011) D. Voet and J.G. Voet, pub. Wiley.
- Molecular Cell Biology” (2021) H. Lodish, et al, pub. W.H. Freeman.
- Molecular Biology of the Cell” (2014) B. Alberts et al., pub. Garland.
- Practical Skills in Biomolecular Sciences” (2016) R. Reed, D. Holmes, J. Weyers and A. Jones, pub. Pearson.
- Principles and Problems in Physical Chemistry for Biochemists” (2001) N.C. Price, R.A. Dwek, R.G. Ratcliffe and M.R. Wormald, pub. Oxford University Press.

Course Title : Fundamentals of Biochemistry (Minor)**Course Code : BCH-513**

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Understand nature of biochemistry |
| CO2 | Know physical and chemical properties of molecules as a linkage of biochemistry |
| CO3 | Learn concept and properties of acid-base relationship |

SEMESTER-I

STA-414: Statistical Methods for Research Workers

Time: 3 Hours

Maximum Marks: 100
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives

- The aim of this course is to understand the basics of statistical methods and their applications in agriculture.
- It helps the students in understanding, analyzing and interpreting the agricultural data.
- It also helps in making appropriate decisions in agricultural research findings.

Theory

Section-A: Probability and fitting of standard frequency distribution, sampling techniques, sampling distributions, mean and standard error.

Section-B: Simple partial, multiple and intra- class correlation and multiple regression.

Section-C: Tests of significance, students'-t, chi-square and large sample tests, confidence intervals.

Section-D: Analysis of variance for one way and two way classification with equal cell frequencies, transformation of data.

Practical

Fitting of distributions, samples and sampling distributions, correlation and regression, tests of significance and analysis of variance.

Note: Students shall be trained to use computer to analysis the data, using available soft wares. However, during university examination students will use scientific calculators to analyse the data.

Suggested Reading

- Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I.The World Press.

- Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
- Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
- Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
- Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
- Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
- Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed. John Wiley
- <http://freeststatistics.altervista.org/en/learning.php>.
- <http://www.statsoft.com/textbook/stathome.html>.

Course Title: Statistical Methods for Research Workers Course Code: STA-414

| Sr. No. | On completing the course, the students will be able to: |
|----------------|---|
| CO1 | Understand the concept of probability, sampling techniques, standard error etc. |
| CO2 | Apply correction and regression techniques. |
| CO3 | Know the use of T-Test, chi-square and large sample tests |

SEMESTER-I

***PGS 501**

Technical Writing & Communication Skills

Time:-3 hours

Maximum Marks: 100

Theory: 100

Credit hours:1 (1+0)

Instructions for the paper setters:

1. The question paper will consist of ten skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5x8=40 marks).
3. There will be four essay type questions from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4x15=60 marks).

Course Objectives

- To equip the students with skills and techniques to write dissertations, research papers, review paper, book chapter and articles etc.
- To equip the students with skills to communicate and articulate in English and scientific language (verbal as well as writing).

Theory:

Technical Writing- Various forms of technical writing-theses, technical papers, reviews, electronics communication etc: qualities of technical writing: parts of research communication- title page, content page, authorship, preface, introduction, review of literature, materials and methods, experimental results, documentation; photographs and drawings with suitable captions; pagination; citation; writing of abstracts; précis; synopsis; editing and proof reading. Communication Skills-defining communication; types of communication- verbal and non-verbal; assertive communication; assertive communication: using language for effective communication; techniques of dyadic communication- message pacing and message chunking, self disclosure mirroring, expressing conversation intent; paraphrasing; vocabulary building- word roots, prefixes, Greek and Latin roots.

Suggested Reading:

- Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
- Holt, Rinehart and 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.
- Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

Course Title: Technical writing & communication skills

Course Code: PGS-501

| Sr. No. | On completing the course, the students will be able to: |
|----------------|--|
| CO1 | Understand the basic components like definitions, descriptions, process explanations and other common forms of technical writing |
| CO2 | Understand how to follow the stages of the writing process and apply them to technical and workplace writing tasks |
| CO3 | Synthesize material collected from primary and secondary sources with their own ideas while writing research papers |

SEMESTER-I

***PGS 502**

Library and Information Services

Time:-3 hours

Maximum marks: 100

Practical : 100

Credit hours:1 (0+1)

Instructions for the Paper Setters:

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible.
The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4×15= 60 Marks)

Course Objectives :

- 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, Stat software, OPAC, search engines, etc.) of information search..

Practical:

Introduction to Library and its services: Five laws of library science: type of documents; classification and cataloguing; organization of documents; sources of information-primary, secondary and tertiary; current awareness and SDI services; tracing information from references sources; library survey; preparation of bibliography; use of Online Public Access Catalogue; use of CD-Rom databases and other computerized library services, CeRA, J-Gate; use of Internet including search engines and its resources, e-resources and access methods.

Course Title Library and Information Services

Course code: *PGS 502

| Sr. No. | On completing the course, the students will be able to: |
|----------------|---|
| CO1 | Understand the library services and its benefit in research work |
| CO2 | Understand how to follow the stages of the writing process along with material available at library resources |
| CO3 | To understand the library services available at desired institute |

SEMESTER-I

***FSC-600 Masters' Research**

**S/US
Credit hours: 4(0+4)**

SEMESTER-II

FSC-521: Sub-Tropical and Temperate Fruit Production

Time: 3 Hours

Maximum Marks : 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objective

- To impart comprehensive knowledge to the students on cultural and management practices for growing subtropical and temperate fruits

Theory

Origin, distribution, commercial importance and export potential. Ecophysiological requirements. Species and varieties. Rootstocks and propagation. Planting, root zone, training and pruning. Nutrition and water requirements, fertigation, role of bio- regulators, major pests, diseases, physiological disorders and their control measures. Abiotic factors limiting fruit production. Flowering, pollination and fruit set. Quality improvement. Storage and ripening techniques. Industrial and export potential, Agri. Export Zones (AEZ) and industrial support. Fruit crops-

Section-A: Apple, pear, plum, peach, quince, kiwifruit, strawberry.

Section-B: Apricot, cherries, hazelnut, walnut, almond, pistachio.

Section-C: Grapes, litchi, loquat, persimmon, mangosteen, carambola, pecan.

Section-D: Bael, wood apple, fig, jamun, rambutan and pomegranate.

Practical:

Description and identification of species and varieties. Growth and development. Growth regulation. Nutritional and physiological disorders and their control. Rejuvenation of old and unproductive trees. Visit to commercial orchards. Project preparation for establishing commercial orchards.

Suggested Reading

- Chadha KL and Awasthi RP. 2005. The Apple. Malhotra Publishing House, New Delhi.
- Chadha TR. 2011. A Text Book of Temperate Fruits. ICAR, New Delhi.
- Childers NF, Morris JR and Sibbett GS. 1995. Modern Fruit Science: Orchard and Small Fruit Culture. Horticultural Publications, USA.
- Creasy G and Creasy L. 2018. Grapes. CAB International.
- Davies FS and Albrigo LG. 1994. Citrus. CAB International.
- Dhillon WS. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.
- Jackson D, Thiele G, Looney NE and Morley-Bunker M. 2011. Temperate and Subtropical Fruit Production. CAB International.
- Ladanyia M. 2010. Citrus Fruit: Biology, Technology and Evaluation. Academic Press.
- Layne DR and Bassi D. 2008. The Peach: Botany, Production and Uses. CABI.
- Menzel CM and Waite GK. 2005. Litchi and Longan: Botany, Production and Uses. CAB International.
- Pandey RM and Randey SN. 1996. The Grape in India. ICAR, New Delhi.
- Rajput CBS, and Haribabu RS. 2006. Citriculture, Kalyani Publishers, New Delhi.
- Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.
- Sharma RM, Pandey SN and Pandey V. 2015. The Pear – Production, Post-harvest Management and Protection. IBDC Publisher, New Delhi.
- Sharma RR and Krishna H. 2018. Textbook of Temperate Fruits. CBS Publishers and Distributors Pvt. Ltd., New Delhi.
- Singh S, Shivshankar VJ, Srivastava AK and Singh IP. 2004. Advances in Citriculture. NIPA, New Delhi.
- Tromp J, Webster AS and Wertheim SJ. 2005. Fundamentals of Temperate Zone Tree Fruit Production. Backhuys Publishers, Lieden, The Netherlands.
- Webster A and Looney N. Cherries: Crop Physiology, Production and Uses. CABI.
- Westwood MN. 2009. Temperate Zone Pomology: Physiology and Culture. Timber Press, USA

Course Title : Sub-Tropical and Temperate Fruit Production Course Code : FSC-521

| | |
|--------|---|
| Sr.no. | On completing the course, the students will be able to |
| CO1 | Equip themselves with principles and practices of producing subtropical (citrus, grapes, litchi, pomegranate, etc.) and temperate fruits (apple, pear, peach, plum, apricot, cherries, berries, kiwifruit, etc.) and nuts (almond, walnut, pecan, etc.) |

SEMESTER-II

FSC-522: Breeding of Fruit Crops

Time: 3 Hours

Maximum Marks: 100
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objective

- To impart comprehensive knowledge on principles and practices of fruit breeding

Theory

Origin and distribution, taxonomical status of species and cultivars. Cytogenetics and genetic resources. Blossom biology, breeding objectives, systems and ideotypes. Crop improvement through introduction, selection, hybridization, mutation breeding, polyploid breeding and rootstock breeding. Improvement of quality traits. Resistance breeding for biotic and abiotic stresses. Biotechnological interventions, achievements and future thrusts in the following selected crops.

Crops:

Section-A: Mango, banana, citrus, litchi.

Section-B: Apple, pear, peach, plum, almond and strawberry.

Section-C: Grapes, guava, papaya.

Section-D: Amla, ber, jamun, phalsa,

Practical:

Characterization of germplasm. Blossom biology and anthesis. Estimating fertility status. Practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical and quality traits. Screening for resistance, developing breeding programme for specific traits. Visit to research stations.

Suggested Reading

- Abraham Z. 2017. Fruit Breeding. Agri-Horti Press, New Delhi.
- Badenes ML and Byrne DH. 2012. Fruit Breeding. Springer Science, New York.

- Dinesh MR. 2015. Fruit Breeding, New India Publishing Agency, New Delhi.
- Ghosh SN, Verma MK and Thakur A. 2018. Temperate Fruit Crop Breeding- Domestication to Cultivar Development. NIPA, New Delhi.
- Hancock JF. 2008. Temperate Fruit Crop Breeding: Germplasm to Genomics. Springer Science, New York.
- Jain SN and Priyadarshan PM. 2009. Breeding Plantation and Tree Crops: Tropical Species. Springer Science, New York.
- Jain S and Priyadarshan PM. 2009. Breeding Plantation and Tree Crops: Temperate Species. Springer Science, New York.
- Janick J and Moore JN. 1996. Fruit Breeding. Vols. I–III. John Wiley & Sons, USA.
- Kumar N. 2014. Breeding of Horticultural Crops: Principles and Practices. NIPA, N. Delhi.
- Moore JN and Janick J. 1983. Methods in Fruit Breeding. Purdue University Press, USA.
- Ray PK. 2002. Breeding Tropical and Subtropical Fruits. Narosa Publ. House, New Delhi

Course Title : Breeding of Fruit Crops

Course Code : FSC-522

| Sr.no. | On completing the course, the students will be able to |
|---------------|--|
| CO1 | Have an understanding on importance and peculiarities of fruit breeding |
| CO2 | Have an updated knowledge on reproductive biology, genetics and inherent breeding systems. |
| CO3 | Have detailed knowledge of various methods/ approaches of breeding fruit crops |

SEMESTER-II

PBG-523 Breeding for Biotic and Abiotic Stress Resistance (Minor)

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours : 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objectives

- Provide examples of strategies and successes of employing plant genetic resources to help plants adapt to climate change.
- To apprise about various abiotic and biotic stresses influencing crop yield, mechanisms and genetics of resistance and methods to breed stress tolerant varieties.

Theory:

Section-A: Plant breeding with reference to biotic and abiotic stress resistance. Biotic stresses in economically important crops. Host defense responses to pathogen invasions. Biochemical and molecular mechanisms. Host-pathogen interactions.

Section-B: Gene-for-gene hypothesis. Acquired and induced immunity. Systemic acquired resistance (SAR). Concept of signal transduction and other host-defense mechanisms against viruses and bacteria. Types and genetic mechanisms of resistance to biotic stresses. Phenotypic screening methods for major pests and diseases.

Section-C: Gene pyramiding. Classification of abiotic stresses - moisture stress/drought, water logging and submergence, wind, acidity, salinity/alkalinity/sodicity, temperature etc. Stress due to soil factors and mineral toxicity. Physiological and phenological responses. Genetics of abiotic stress resistance.

Section-D: Genes and genomics in breeding for abiotic stresses. Utilizing MAS procedures. Breeding for resistance to abiotic stresses. Exploitation of wild relatives as a source of resistance to biotic and abiotic factors in major field crops. Transgenics in management of biotic and abiotic stresses.

Practical:

Phenotypic screening techniques for sucking pests, chewing pests, nematodes and borers. Use of standard MAS procedures. Phenotypic screening methods for diseases caused by fungi and bacteria. Screening crops for drought, flood resistance, acidity, alkalinity and temperature etc.

Suggested Reading:

- Blum A. 1988. Plant Breeding for Stress Environments. CRC Press.
- Christiansen MN and Lewis CF. 1982. Breeding Plants for Less Favourable Environments. Wiley International.
- Fritz RS and Simms EL. (Eds.). 1992. Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics. The University of Chicago Press.
- Li PH and Sakai A. 1987. Plant Cold Hardiness. Liss, New York Springer
- Luginpill P. 1969. Developing Resistant Plants - The Ideal Method of Controlling Insects. USDA, ARS, Washington DC.
- Maxwell FG and Jennings PR. (Eds.). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons. Wiley-Blackwell.
- Roberto F. 2018. Plant Breeding for Biotic and Abiotic Stress Tolerance. Springer.
- Russel GE. 1978. Plant Breeding for Pest and Disease Resistance. Butterworths.
- Sakai A and Larcher W. 1987. Frost Survival in Plants. Springer-Verlag.
- Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.
- Turener NC and Kramer PJ. 1980. Adaptation of Plants to Water and High Temperature Stress. John Wiley & Sons.
- Van Der Plank JE. 1982. Host-Pathogen Interactions in Plant Disease. Academic Press

Course Title : Breeding for Biotic and Abiotic Stress Resistance (Minor)

Course Code : PBG-523

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Understand the genetic mechanisms of biotic and abiotic stresses. |
| CO2 | Learn phenotyping screening methods for major pest and diseases. |
| CO3 | Learn about the source of resistance. |

SEMESTER-II

BCH-523

Experiments in Biochemistry (Minor)

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objective

- To familiarize the students with major biomolecules namely carbohydrates, lipids, proteins and nucleic acids which are important for the structural organization and functions of the cells.

Theory:

Section-A: Concepts of pH and buffers. Determination of total sugars, reducing and non-reducing sugars, starch, freefatty acids, cholesterol and phospholipids.

Section-B: Determination of free amino acids and proteins. Separation of sugars by paper chromatography. Extraction of lipids, separation of polar and non-polar lipids by TLC.

Section-C: Fatty acid composition by GLC. Estimation of Vitamin C and tocopherols. Isolation and purification of acid phosphatase.

Section-D: Estimation of chlorophyll, carotenoids and phytic acid. Extraction and estimation of nucleic acids.

Practical: Preparation of buffer solutions. Estimation of sugars, starch and lipids. Extraction of lipids. Separation of sugars by paper chromatography. Estimation of Vitamin C, chlorophyll and carotenoids. Extraction and estimation of nucleic acids.

Suggested Reading

- Biochemistry” (2019) J.M. Berg, J.L. Tymoczko, G.J. Gatto and L. Stryer, pub. W.H. Freeman.
- Biochemistry” (2011) D. Voet and J.G. Voet, pub. Wiley.
- Molecular Cell Biology” (2021) H. Lodish, et al, pub. W.H. Freeman.
- Molecular Biology of the Cell” (2014) B. Alberts et al., pub. Garland.

- Practical Skills in Biomolecular Sciences” (2016) R. Reed, D. Holmes, J. Weyers and A. Jones, pub. Pearson.
- Principles and Problems in Physical Chemistry for Biochemists” (2001) N.C. Price, R.A. Dwek, R.G. Ratcliffe and M.R. Wormald, pub. Oxford University Press.

Course Title : Experiments in Biochemistry (Minor)

Course Code : BCH-523

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Understand in detail the structure and physico chemical properties of carbohydrates from monosaccharide to polysaccharides. |
| CO2 | Learn the significance of structural and storage polysaccharides in nature |
| CO3 | Understand the difference between the water soluble and fat soluble vitamins and their key role in the metabolism as coenzymes. |

SEMESTER-II

STA-524: Experimental Designs for Research Workers

Time: 3 Hours

Maximum marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objectives

- The aim of this course is to understand the basics of statistical methods and their applications in agriculture.
- It helps the students in understanding, analyzing and interpreting the agricultural data.
- It also helps in making appropriate decisions in agricultural research findings.

Theory:

Section-A: Need for designing of experiments- characteristics of a good design, basic principles-randomization, replication and local control, uniformity trials- size and shape of plots and blocks, analysis of variance and interpretation of data.

Section-B: Completely randomized, randomized block and latin square design, multiple comparison tests, factorial experiments- interpretation of main effects and interactions,

Section-C: Orthogonality and partitioning of degrees of freedom confounding in 2 3 , 2 4 and 3 3 designs, split and strip plot designs, crossover designs and balanced incomplete block designs, response surface designs, switch over trials and long term experiments;

Section-D: Selection of experimental design, mechanical errors in field experiments and methods of reducing it, presentation of research results.

Practical:

Uniformity trials, completely randomized, randomized block and latin square designs missing plot and analysis, of covariance, 2 3 ,2 4 and 3 3 simple and confounded experiments, split and strip plot designs, cross over Uniformity trials, completely randomized, randomized block and latin square designs, missing plot and analysis, of covariance, 2 3 ,2 4 and 3 3 simple and

confounded experiments, split and strip plot designs, cross over and balanced incomplete block designs.

Note: Students shall be trained to use computer to analysis the data, using available soft wares. However, during university examination students are allowed to use scientific calculators to analysis is the data.

Note: Students are allowed to use scientific calculator in University examinations; statistical tables will be provided to students in examinations. No rigorous mathematical proofs are expected from students; stress will be on application only.

Suggested Reading

- Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.
- Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
- Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.

Course Title: Experimental Designs for Research Workers

Course Code: STA-424

| Sr.no. | On completing the course, the students will be able to |
|---------------|--|
| CO1 | Get knowledge on the designs, their principles, analysis of variance and interpretation of data. |
| CO2 | Study various mechanical errors in field experiments, methods of reducing them and presentation of research results. |

SEMESTER-II

*PGS-503 – Agricultural Research & Publication Ethics

Time: 3.00 Hours

Maximum Marks: 100

Theory: 100

Credit hours: 1 (1+0)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 marks each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions will be asked from each Section out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (20).

Course Objective

- The aim of this course is to understand the moral judgment and reactions. Identify the publication misconduct, scientific misconduct, complaints and appeals.

Theory:

Section-A: Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Section-B: Publication ethics: definition, introduction and importance. Best practices/standards setting initiative and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, type.

Section-C: Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals. Ethics with respect to science and research. Intellectual honesty and research integrity.

Section-D: Scientific misconduct: Falsification, Fabrication, and Plagiarism (FFP); Redundant publication: duplicate and overlapping publication, salami slicing; selective reporting and misrepresentation of data.

Suggested Reading:

- Bhalla GS and 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.

Course Title: Agricultural research and publication ethics Course Code: PGS-503

| Sr. No. | On completing the course, the students will be able to: |
|----------------|--|
| CO1 | Understand the moral judgment and reactions |
| CO2 | Identify the publication misconduct, scientific misconduct, complaints and appeals |

SEMESTER-II

***FSC-600**

Masters Research

S/US

Credit hours: 4(0+4)

SEMESTER-III

FSC-531: Principles and Practices of Plant Propagation.

Time: 3 Hours

Maximum marks: 100
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objective

- To understand the principles and methods of propagation and nursery management in fruit crops

Theory:

Section-A: Introduction, life cycles in plants, cellular basis for propagation. Sexual propagation, apomixis, polyembryony, chimeras.

Section-B: Factors influencing seed germination, hormonal regulation of germination and seedling growth. Seed quality, treatment, packing, storage, certification and testing. Rooting of cuttings under mist and hot beds. Physiological, anatomical and biochemical aspects of root induction in cuttings.

Section-C: Selection of elite mother plants. Establishment of bud wood bank. Stock, scion and inter stock relationship and Incompatibility. Physiology of dwarfing rootstocks. Rejuvenation. Progeny orchard and scion bank.

Section-D: Micro-propagation - in vitro clonal propagation, direct organogenesis, embryogenesis, micrografting and Meristem culture. Hardening, packing and transport of micro-propagules. Nursery structures.

Practical:

Anatomical studies in rooting of cutting and graft union. Propagation structures. Use of media and PGR. Micropropagation and hardening of plants. Explant preparation, media preparation, culturing in vitro, clonal propagation, meristem culture, shoot tip culture, axillary bud culture., Micro grafting and hardening. Visit to TC labs and nurseries.

Suggested Reading

- Bose TK, Mitra SK and Sadhu MK. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash, Kolkatta.
- Davies FT, Geneve RL and Wilson SB. 2018. Hartmann and Kester's Plant Propagation Principles and Practices. Pearson, USA/ PrenticeHall of India. New Delhi.
- Gill SS, Bal JS and Sandhu AS. 2016. Raising Fruit Nursery. Kalyani Publishers, New Delhi.
- Jain S and Ishil K. 2003. Micropropagation of Woody Trees and Fruits. Springer.
- Jain S and Hoggmann H. 2007. Protocols for Micropropagation of Woody Trees and Fruits. Springer.
- Joshi P. 2015. Nursery Management of Fruit Crops in India. NIPA, New Delhi.
- Love et al. 2017. Tropical Fruit Tree Propagation Guide. UH-CTAHR F_N_49. College of Tropical Agriculture and Human Resources University of Hawaii at Manwa, USA.
- Peter KV, eds. 2008. Basics of Horticulture. New India Publishing Agency, New Delhi.
- Rajan S and Baby LM. 2007. Propagation of Horticultural Crops. NIPA, New Delhi.
- Sharma RR. 2014. Propagation of Horticultural Crops. Kalyani Publishers, New Delhi.
- Sharma RR and Srivastav M. 2004. Propagation and Nursery Management. Intl. Book Publishing Co., Lucknow.

Course Title : Principles and Practices of Plant Propagation Course Code : FSC-531

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Acquire skills and knowledge on principles and practices of macro and micropropagation techniques |
| CO2 | Handle propagated material in the nursery |

SEMESTER-III

FSC-532: Plant Growth Regulators in Fruit Crops

Time: 3 Hours

Maximum Marks: 100
Theory: 50
Practical: 25
Internal assessment :25
Credit hours : 3(2+1)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objectives :

- To expose students to an understanding of the hormonal and environmental regulation of plant growth and development.
- The course focuses on mechanisms on the molecular, cell and organism level that control the different phases in the development of the plant such as embryogenesis, germination, vegetative growth and reproductive growth.

Theory

Section-A: History, nomenclature, role and physiological effects of plant growth regulators in fruit crops;

Section-B: Methods of application of growth regulators; Methods of isolation and estimation; Mechanism of action;

Section-C: Role of plant regulators in plant propagation, seed dormancy, apical dominance, rooting of cutting, flower initiation, fruit set and fruit development;

Section-D: Role of plant regulators in flower and fruit thinning, parthenocarpy, fruit drop and induced fruit abscission, fruit ripening and quality improvement in fruit crops.

Practical:

Preparation of growth regulator solutions; Methods of application; Application in plant propagation, prevention of flower and fruit drop; induction of parthenocarpy, fruit set, fruit thinning, fruit ripening and quality improvement; Isolation and bioassays for the estimation of plant regulators.

Suggested Reading

- Hopkins, WG & Huner NPA.2004. Introduction to plant physiology. John Wiley & sons.
- Hota,Dharamvir. 2007.Synthetic plant growth regulators.
- Basra. A.S.,2004.Plant Growth regulators in Agriculture and Horticulture, International Book Distributing Co.

Course Title : Plant Growth Regulators in Fruit Crops**Course Code : FSC-532**

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Learn the physiological role of various PGRs in fruit plants. |
| CO2 | Understand the various methods of application, methods of isolation and estimation along with mechanism of action of PGRs in fruit plants. |
| CO3 | Students will be able to prepare various PGRs solution having different concentrations. |
| CO4 | Learn the role of PGRs in plant propagation, seed dormancy, apical dominance, rooting of cuttings, flower initiation, fruit set and quality |

SEMESTER-III

PBG-430 Maintenance Breeding and Concepts of Variety Release and Seed Production (Minor)

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment :25

Credit hours :3 (2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objectives

- To impart knowledge on principles of seed production and certification.
- This will help the students to understand seed production practices and seed certification procedures in different crops

Theory:

Section-A: Variety development and maintenance. Defining variety, cultivar, extant variety, derived variety, reference variety, farmers' variety, hybrid and population.

Section-B: Variety testing, release and notification systems in India and abroad. US testing. Genetic deterioration of varieties.

Section-C: Maintenance of varieties. Principles of seed production. Generation system of seed multiplication. Quality seed production of cereals and millets, pulses, oilseeds, cotton and forages.

Section-D: Seed certification. Seed laws and plant variety protection regulations in India and international systems.

Practical:

Identification of suitable areas for seed production. Ear-to-row method and nucleus seed production. Main characteristics of released and notified varieties, hybrids and parental lines. Identification of important weeds/objectable weeds. Determination of isolation distance and planting ratios in different crops. Seed production techniques of varieties in different crops. Hybrid seed production technology of important crops.

Suggested Reading:

- Agarwal RL. 1997. Seed Technology. 2nd Ed. Oxford & IBH.
- Kelly AF. 1988. Seed Production of Agricultural Crops. Longman.
- McDonald MB Jr and Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall.
- Poehlman JM and Borthakur D. 1969. Breeding Asian Field Crops. Oxford & IBH.
- Singh BD. 2005. Plant Breeding: Principles and Methods. Kalyani. 2015
- Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill

Course Title : Maintenance Breeding and Concepts of Variety Release and Seed Production (Minor) Course Code : PBG-430

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Know about seed production of different crop varieties and hybrids, their processing, marketing and seed laws |

SEMESTER-III

BCH-430

Fundamentals of Nutritional Biochemistry(Minor)

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment :25

Credit hours :3 (2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All questions will carry equal marks (10).

Course Objectives

- To understand the chemical characteristics of different classes of nutrients with reference to their physical properties, and to relate this to their functions in the body.
- To explain the processes of digestion, absorption and metabolism of the macronutrients and micronutrients in the context of different meals.

Theory:

Section-A Role of major biomolecules in nutrition. Structure and physiological role of vitamins. Basal metabolism and caloric requirements.

Section-B Balanced diet. Metabolic disorders of carbohydrates and lipids. Evaluation of protein quality by chemical and biological methods.

Section-C Protein malnutrition. Detoxification and excretion of anti-metabolic agents and other drugs. Biochemical functions of minerals.

Section-D Anti-nutrients, antioxidants in human health. Pre and Probiotics.

Practical

Study of biomolecules and their role in nutrition. Role of vitamins. Evaluation of protein quality by chemical and biological methods. Biochemical functions of minerals. . Pre and Probiotics

Suggested Reading

Biochemistry” (2019) J.M. Berg, J.L. Tymoczko, G.J. Gatto and L. Stryer, pub. W.H.

- Freeman.
- Biochemistry” (2011) D. Voet and J.G. Voet, pub. Wiley.
 - Molecular Cell Biology” (2021) H. Lodish, et al, pub. W.H. Freeman.
 - Molecular Biology of the Cell” (2014) B. Alberts et al., pub. Garland.
 - Practical Skills in Biomolecular Sciences” (2016) R. Reed, D. Holmes, J. Weyers and A. Jones, pub. Pearson.
 - Principles and Problems in Physical Chemistry for Biochemists” (2001) N.C. Price, R.A. Dwek, R.G. Ratcliffe and M.R. Wormald, pub. Oxford University Press.

Course Title : Fundamentals of Nutritional Biochemistry(Minor)Course Code : BCH-430

| Sr.no. | On completing the course, the students will be able to |
|---------------|--|
| CO1 | Capable of describing biochemical pathways relevant in nutrient metabolism. |
| CO2 | Capable of describing biochemical techniques that are relevant for the investigation of the nutrient metabolism. |

SEMESTER-III

FSC-591

CREDIT SEMINAR

Maximum marks : 100

Credits hours: 1(1+0)

SEMESTER-III

*PGS-504 Intellectual Property & its Management in Agriculture

Time: 3 Hours

Maximum marks: 100

Theory: 100

Credit hours: 1 (1+0)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

Course Objectives:

- To equip students with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance
- Use of IPR as a tool for wealth and value creation in a knowledge based economy.

Theory:

Section A: 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 IPRs.

Section B: 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 biodiversity protection.

Section C: Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity.

Section D: International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Reading:

- Erbisch FH and 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 and Aesthetic Technologies. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and 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.

Course Title: Intellectual Property & its Management in Agriculture

Course Code: PGS 504

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | The students will have acquaintance of intellectual property rights |
| CO2 | Understand the various methods of application, methods of isolation and estimation along with mechanism of action of PGRs in fruit plants. |
| CO3 | Students will be able to prepare various PGRs solution having different concentrations. |
| CO4 | Learn the role of PGRs in plant propagation, seed dormancy, apical dominance, rooting of cuttings, flower initiation, fruit set and quality |

SEMESTER-III

***FSC-600**

***Masters' Research**

S/US
Credits hours: 6(0+6)

SEMESTER-IV

FSC-541:

Citriculture

Time: 3 Hours

Maximum Marks: 100
Theory: 50
Practical: 25
Internal assessment =25
Credit hours :3(2+1)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. Each question will carry equal marks (10).

Course Objective

- The main aim of this course is to impart training to the students with regard to reorganization of citrus species, their propagation and cultural practices in citrus cultivation.

Theory:

Section-A: Origin, distribution and commercial importance: Important cultivated species and varieties:

Section-B: Propagation and rootstocks climatic and soil requirements:

Section-C: Training and pruning: Intercropping and weed control. Fertilization and irrigation:

Section-D: Physiological and pathological disorder and their control: Harvesting and handling of fruits.

Practical:

Description and identification of different citrus species and cultivars: Training and pruning: study of various stionic combinations: identification of rootstocks through chemical test: weed control: control of fruit drop: nutritional disorders: Quality analysis: fertilization and irrigation.

Suggested Readings

- Bartholomew DP, Paull RE and Rohrbach KG. 2002. The Pineapple: Botany, Production, and Uses. CAB International.
- Bose TK, Mitra SK and Sanyal D. 2002. Fruits of India – Tropical and Sub-Tropical.3rd Edn. Naya Udyog, Kolkata.
- Dhillon WS. 2013. Fruit Production in India. Narendra Publ. House, New Delhi.

- Iyer CPA and Kurian RM. 2006. High Density Planting in Tropical Fruits: Principles and Practices. IBDC Publishers, New Delhi.
- Litz RE. 2009. The Mango: Botany, Production and Uses. CAB International.
- Madhawa Rao VN. 2013. Banana. ICAR, New Delhi.
- Midmore D. 2015. Principles of Tropical Horticulture. CAB International.
- Mitra SK and Sanyal D. 2013. Guava, ICAR, New Delhi.
- Morton JF. 2013. Fruits of Warm Climates. Echo Point Book Media, USA.
- Nakasome HY and Paull RE. 1998. Tropical Fruits. CAB International.
- Paull RE and Duarte O. 2011. Tropical Fruits (Vol. 1). CAB International.
- Rani S, Sharma A and Wali VK. 2018. Guava (*Psidium guajava* L.). Astral, New Delhi.
- Robinson JC and Saúco VG. 2010. Bananas and Plantains. CAB International.
- Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.
- Schaffer B, Wolstenholme BN and Whiley AW. 2013. The Avocado: Botany, Production and Uses. CAB International.
- Sharma KK and Singh NP. 2011. Soil and Orchard Management. Daya Publishing House, New Delhi.
- Valavi SG, Peter KV and Thottappilly G. 2011. The Jackfruit. Stadium Press, USA

Course Title : Citriculture

Course Code : FSC-541

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Students will be able to identify different citrus species and cultivars. |
| CO2 | Understand the various cultural practices for its cultivation |
| CO3 | Know the post harvest handling of citrus fruits. |

SEMESTER-IV

FSC-542: Orchard Floor Management and Organic Agriculture

Time: 3 Hours

Maximum Marks: 100
Theory: 50
Practical: 25
Internal assessment =25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. Each question will carry equal marks (10).

Course Objective

- To develop understanding on organic production of fruit crops.

Theory:

Section-A: Soil quality and its management for orchard plantation. Effect of soil organic matter on physico-chemical characteristics of the soil.

Section-B: Moisture conservation and water requirement for fruit crops. Principles, methods and scheduling of irrigation. Principles and status of organic horticulture. Organic farming systems.

Section-C: Organic inputs and their role. EM technology and its impact. Indigenous practices of sustainable soil fertility, weed management and biological/natural control of pests and diseases. Fruit quality improvement.

Section-D: Good Agricultural Practices (GAP), HACCP and certification of organic products. Standards evolved by different agencies. Constraints in certification, organic horticulture and export.

Practical:

Different methods of irrigation. Mulching and weed control in orchards. Determination of soil organic matter. Inter-cropping exercise. Input analysis of manures. Bio-composting, biofertilizers and their application. Methods of preparation of organic manures. EM technology and products. Biological/natural control of pests and diseases. Soil solarization. Case studies. Residue analysis in organic products and documentation.

Suggested Reading

- Claude A. 2004. The Organic Farming Sourcebook. Other India Press, Mapusa, Goa, India.
- Dabholkar SA. 2001. Plenty for All. Mehta Publishing House, Pune, Maharashtra.
- Das HC and Yadav AK. 2018. Advances in Organic Production of Fruit Crops. Westville Publishing House, New Delhi.
- Deshpande MS. 2003. Organic Farming with respect to Cosmic Farming. Mrs. Pushpa Mohan Deshpandey, Kolhapur, Maharashtra.
- Deshpande WR. 2009. Basics of Organic Farming. All India Biodynamic and Organic Farming Association, Indore.
- MP. Gaur AC, Neblakantan S and Dargan KS. 1984 Organic Manures. ICAR, New Delhi.
- Lampkin, N. and Ipswich, S. 1990. Organic Farming. Farming Press. London, UK.
- Lind K, Lafer G, Schloffer K, Innershofer G and Meister H. 2003. Organic Fruit Growing. CAB International.
- Palaniappan SP and Annadurai K. 2008. Organic Farming- Theory and Practice. Scientific Publishers, Jodhpur, Rajasthan, India.
- Palekar S. 2004. The Technique of Spritual Farming. Chandra Smaritee, Sai Nagar, Amrawati, Maharashtra.
- Proctor P. 2008. Biodynamic Farming and Gardening. Other India Press, Mapusa, Goa. Ram RA and Pathak RK. 2017. Bioenhancers. Lap Lambert Academic Publishing, A.P.

Course Title : Orchard Floor Management and Organic Agriculture

Course Code : FSC-542

| Sr.no. | On completing the course, the students will be able to |
|---------------|--|
| CO1 | Familiarize with the concepts and practices of organic and other natural farming systems |
| CO2 | Generate know-how on procedures, policies and regulation for inspection and certification of organic produce |

SEMESTER-IV

PGS-505 Disaster Management

Time: 3 Hours Credit hours: 1(1+0)

Max. Marks: 100

Theory: 100

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

Course objectives:

- To impart knowledge about natural and man-made disasters.
- To impart knowledge about different management strategies during disasters

Theory:

Section A: hazards and disasters, risk and vulnerability in disasters, natural and man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Section B: Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) earthquakes, landside).social economics and environmental impact of disasters.

Section C: Basic principles of disasters management, disaster management cycle, disaster management policy. national and state bodies for disaster management, early warning systems ,building design and construction in highly seismic zones, retrofitting of buildings.

Section D: Training and drills for disaster preparedness, awareness generation program, usages of GIS and remote sensing techniques in disaster management, mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

Suggested reading

- Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
- Damon, P. Copola, (2006) Introduction to International Disaster Management, ButterworthHeinemann.
- Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
- Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New
- Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Course Title: Disaster Management

Course Code: PGS-505

| Sr.no. | On completing the course, the students will be able to |
|---------------|---|
| CO1 | Study the different hazards, disasters, risk and vulnerability during disasters, |
| CO2 | Mitigate and manage techniques of different natural and man made hazards |
| CO3 | Gain training and awareness programs to control the risk of different kind of hazards |
| CO4 | Use remote sensing tools for risk assessments and preparedness |

SEMESTER-IV

***FSC-600**

***Masters' Research**

S/US

Credits hours: 6(0+6)