Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Sub: Minutes of 21st Meeting of Academic Council, SKUAST- Jammu

The minutes of 21st Academic Council meeting held on 25th of November, 2020, duly approved by the competent authority is enclosed herewith for kind perusal.

JP Sharma
Registrar
11/02/21

No: AUJ/Acad/20-21/ F-08/ 7068-7128.
Dated: 11 -02-2021

Copy to:

- Members of Academic Council
- Comptroller, SKUAST- Jammu
- Dy. Registrar, (Secy.) for information.
- SVC for kind information of Hon'ble Vice Chancellor

Minutes of 21st Academic Council Meet of SKUAST-Jammu

The 21st meet of Academic Council of SKUAST Jammu was convened on 25th Nov., 2020 at Conference Hall, Main Campus, SKUAST-Jammu, Chatha under the chairmanship of Prof. J.P. Sharma, Hon'ble Vice-Chancellor of the University. The social distancing and other SoPs of Covid-19 pandemic issued by UT of J&K Govt. were followed in the meeting. The list of members and special- invitees who attended the meeting is given in **Annexure-I**. At the commencement of meeting Sh. Rajesh Talwar, Registrar Ex-offico, Member Secretary of the Academic council of SKUAST-Jammu welcomed the Chairman and other members and special- invitees in the meeting. The Hon'ble Vice-Chancellor in his opening remarks expressed the satisfactory progress has been made in academics, research and extension activities of the University. After obtaining the formal permission from Chairman the Member Secretary presented the agenda of the meeting. The following agenda items were deliberated upon.

Agenda Item No. AC (21) 1 : **Confirmation of the minutes of 20th Meeting of the Academic Council**

The Member Secretary apprised the house that the minutes of 20th meeting of Academic Council held on 27th May ,2020 were circulated among the members vide no. AUJ/Acad/2020-21/F-08/244-80 dated 08-06-2020. The Hon'ble Vice-Chancellor asked the members for comments/disagreement in the minutes, if any. All the members confirmed the 20th minutes of the Academic Council. After that the house unanimously adopted the following resolution:

"Resolved that the minutes of 20th meeting of Academic Council circulated vide no. AUJ/Acd/ 2020-21/F-08/244-80 dated 08-06-2020 were confirmed."

Agenda Item No. AC (21) 2 : **Institutionalisation of Ph.D. programme in (Agri-Business Management) from Academic Session 2020-21.**

The Member Secretary informed that the SKUAST-Jammu is the only institution in the Union Territory of J&K to impart MBA (ABM) degree programme and there is a growing demand of the students to institutionalize Ph.D. (Agri-Business Management)) degree programme for providing platform for advanced learning. This effort would further empower skillful professionals to understand and explore the Agri-business environment with in-depth study. The updated course curriculum of Ph.D. (Agri-Business Management) was presented before the house. The Chairman remarked that semester-wise fee structure of the course be included. Director Education informed the house that the XVIth meeting of Board of Studies, Faculty of PG studies held on 01-07-2020 at agenda no. BOS-PG (XVI) 1 and XVth meeting of Faculty of PG Studies at agenda no F-PGS (XV)1 and Board of Studies Faculty of PG Studies have already passed agenda of institutionalization of Ph.D.(Agri-Business Management) with intake capacity of two (02) along with detailed deliberations on syllabus and other requirement. Dr Jyoti Kachroo, Prof & Head , Division of Agri. Economic & ABM informed the house that the Division has sufficient infrastructure, resources and other facilities to start the Ph.D. programme in Agri Business Management from academic session 2020-21. However, she urged the house to increase the remuneration of the contractual teachers.

Hon'ble Vice-Chancellor directed Dr. R K Salgotra, Coordinator, School of Biotechnology to submit the detail proposal for increasing the remuneration of contractual teachers on the same analogy of UT Govt. ICAR/UGC. After detailed deliberations and discussion, the following resolution was adopted

"Resolved that:

i. ***Ph.D.(Agri-Business Management) from academic session 2020-21 with an intake capacity of two (02) be Institutionalized.***

ii. ***The eligibility requirement for admission to Ph.D. (Agri-Business) be MBA (ABM) or any MBA stream or equivalent.***

iii. ***The Programme shall be run on self financing mode and the semester fee of the programme be fixed as Rs. 30,000/- semester in addition to normal semester fee.***

iv. ***The course curriculum of the Ph.D (Agri-Business Management) annexed as annexure-I be adopted".***

Agenda Item No. AC (21) 3 : Restructuring intake capacity for Diploma in Agriculture and Diploma in Horticulture

The Member Secretary informed the house that Diploma in Agriculture and Diploma in Horticulture had 40 seats each out of which 30 seats were reserved for fresh candidates and 10 seats for in-service J&K Government/ SKUAST-J nominees and the 30 seats further reserved district wise i.e. 03 seats for each district. Restriction of 03 seats per district reduced the prospects of genuine candidates from other district. Therefore, the University waved off the restriction of 03 seats per district vide notification no 44 (Acad) of 2020 dated 01-09-2020. Dr Hans Raj, Head, Division of Surgery and Radiology impressed that social reservation as per current reservation policy in the UT of J&K may also be given in diploma course. After detail deliberations and discussion, the following resolution was adopted:

"Resolved that:

i. ***The decision taken by the University regarding waiving off the reservation of 03 seats per district vide notification no 44 (Acad) of 2020 dated 01-09-2020 and inviting the applications for intake of 30 seats each in Diploma courses in Agriculture and Horticulture for Jammu province was ratified.***

ii. ***The intake of 10 seats in each Diploma course for in-service UT Government / SKUAST-J, employees be fixed from the academic session 2020-21.***

iii. ***The reservation to Diploma courses given as per*** **the Jammu & Kashmir Reservation Rules, 2005 amended vide SO 127 dated 20/04/2020** ***is adopted from the academic session 2020-21".***

Agenda Item No. AC (21) 4 : Institution of Ph.D. in Floriculture and Landscaping

The Member Secretary appraised the house that Chairman Faculty of PG Studies vide no. AUJ/DE/20-21/F-125/1398 dated 11/11/2020 informed that the agenda of institution of Ph.D. in Floriculture and Landscaping Architecture has already been approved by Board of Studies. Prof R K Gupta, Director Research informed the house that the course curriculum for Ph.D. in Floriculture and Landscape Architecture annexed as **Annexure-IV** is similar to ICAR curriculum Further, has emphasized that Division of Vegetable Sciences & Floriculture had sufficient infrastructure, manpower and other facilities for running the course. The matter was deliberated and discussed in the meeting; and thereafter, the following resolution was adopted:

"Resolved that:

i. **Ph.D Floriculture and Landscaping be institutionalised from the academic session 2020-21 with an intake capacity of two (02).**
ii. **The course curriculum of the Ph.D. in Floriculture and Landscaping annexed as annexure-IV is adopted".**

Agenda Item No. AC (21) 5 : Enhancement of 10 percent seats under Economically Weaker Section in each programme from academic session 2020-21 and onwards.

The Member Secretary, informed the house that the Jammu & Kashmir Reservation Rules, 2005 amended vide SO 127 dated 20/04/2020 have been issued by Government of Jammu & Kashmir, Social Welfare Department,

issued by Government of Jammu & Kashmir, Social Welfare Department, wherein 10% over and above reservation of the existing seats is given to the Economically Weaker sections (EWSs) for Undergraduate and Post-graduate Programmes. The Social Welfare Department vide its OM No. SW/PSP/04/2017 dated 09-05-2020 has already clarified that benefits of reservation under Economically Weaker Sections clause/category shall be available only in respect of those institutions where the intake capacity has been increased by 10 % over and above its annual permitted strength in each branch of study and faculty so that the number of seats available exceeding those reserved for the persons' belonging to the EWSs, are not less than the total seats available the immediately preceding academic session . Therefore, the University issued notification no. 46 (Acad) of 2020 dated 28-09-2020 for seat matrix for UG & PG Programme (open/reserved) by including 10% seats of Economically Weaker Section (EWSs). The matter was deliberated in the meeting and following resolution was made:

"Resolved to ratify the decision taken by the university vide* notification no. 46 (Acad) of 2020 dated 28-09-2020 for seat matrix for UG & PG Programme (open/reserved) by including 10% seats of Economically Weaker Section (EWSs) *over and above the total intake capacity from academic session 2020-21 and onwards".

Agenda Item No. AC (21) 6 : **Ratification of Annual Board of Examination for B.V.Sc. & AH through online mode and supplementary Examination for 1st semester 2019-20.**

The Member Secretary informed that in view of the situation developed due to Covid-19 Pandemic, the university vide No. AUJ/Acad/20-21/F-59/1591-94 dated 24-08-2020 allowed to conduct the Annual Board Examination for B.V.Sc. & AH through online mode and also granted permission for conduct of supplementary examination for 1st semester of academic session 2019-20 vide no AUJ/Acad/20-21/F-45/1771-75 dated 9-

9-2020. The matter was deliberated by the Hon'ble members of Academic Council and following resolution adopted:-

"Resolved that the decision taken by the university vide no. AUJ/Acad/20-21/F-59/591-94 dated 24-08-2020 for conduct of Annual Board Examination for B.V.Sc. & AH programme through online mode and vide No. AUJ/Acad/20-21/F-45/1771-75 dated 9-9-2020 for conduct of supplementary examination for 1st semester of academic session 2019-20 is ratified."

Agenda Item No. AC (21) 7 : Deferment of educational tour.

Dean, F.V.Sc. & A.H vide no AUJ/FVSc./ AC/20-21/F-20/2311 dated 18-11-2020 informed that under the present circumstances arising due to COVID-19 pandemic, it is neither feasible to conduct tour for a batch of more than 70 students nor advisable to go on educational tours; and the condition is unlikely to improve in near future to such an extent where these tours can be conducted ensuring the safety of the students and arranging accommodation for more than 70 students. The Hon'ble Vice-Chancellor pointed out that education tour is an important activity and the students get exposure through visiting various institutions. Keeping in view the present situation such tours be restricted to North India. The matter was deliberated and discussed by Hon'ble member of Academic Council and following resolution was adopted:

"Resolved that the mandatory All India Education tour be restricted to North India states".

Agenda Item No. AC (21) 8 : Institutionalization of PG programme in M.Sc. (Seed Science & Technology) Programme from academic session 2021-22.

The Member Secretary informed the house that Nodal officer (Seed) submitted the proposal for the institution of PG course as M.Sc. (Seed Science & Technology) from the academic session 2021-22. The Nodal Officer (Seed)

other PG courses run by this University. Dean, FoA pointed out that the facilities such as instruments, Labs, and infrastructure available at Seed Testing Unit be utilized. The Hon'ble Vice-Chancellor remarked that rooms of Seed Testing Unit need some modifications and alteration. After doing such modifications, the M.Sc. Seed Sciences & Technology can be run from said building. Dr SEH Rizvi appraised that non-credit courses may also be included in the course curriculum of M.Sc. Seed Sciences & Technology. The matter was deliberated and discussed by Hon'ble member of Academic Council and following resolution was adopted:

"Resolved that:

i. ***MSc. (Seed Science & Technology) for the academic session 2021-22 with an intake capacity of three (03) may be institutionalised.***

ii. ***The course curriculum, eligibility criteria of the MSc. (Seed Science & Technology) annexed as annexure-IX be adopted".***

Agenda Item No. AC (21) 9 : **Conduct of written Comprehensive examination during Ist semester of academic session 2020-21**

The Member Secretary informed the house that the university decided to conduct written comprehensive examination during Ist semester of academic session 2020-21 on internal basis keeping in view the Covid-19 pandemic situation. Director Education stressed that it would be difficult to evaluate the comprehensive examination externally under the restricted movement situation. The matter was deliberated and discussed in the meeting and the following resolution was adopted:-

"Resolved that the paper setting and evaluation of written comprehensive examinations for Master and Ph.D. degree programmes during Ist semester of academic session 2020-21 be held internally".

Agenda Item No. AC (21)10 : Any other Agenda item with the permission of the chair

1. **Reallocation one Post for Linguistics**

Prof Rajinder Peshin informed that Technical Writing is an essential course and students of UG and PG programmes were facing the problem due to non availability of permanent staff member of linguistics. The university usually hired contractual/guest lecturer for teaching such course. Therefore, in-order to address the problem, one teaching post may be allocated for Linguistics course. The service of Linguistics shall also be used in preparing, checking the editing draft of various reports, speeches, projects etc. Hon'ble Vice-Chancellor remarked that new education policy 2020 focused upon the development of languages as well with technical education growth. In order to implement the new education policy a proposal shall be floated to Govt. for sanctioning the posts for languages. For this a committee of Director and Deans may be framed to chalk-out the modalities for implementation of new education policy. Dean, FoA urged that a contractual teacher may be engaged for teaching the language course. The matter was deliberated and discussed in the meeting and the following resolution was adopted:-

"Resolved that:

i. ***A contractual teacher shall be engaged for teaching language course in the University. The fund of School of Biotechnology be utilize for contractual engagement".***
ii. ***A committee of Director Education & Deans shall be framed to implement the New Education Policy, 2020 in the University".***

2. **Reallocation of 04 seats reserved for In-service- Govt. Nominee in B.V.Sc.& A.H programme**

The Dean, F.V.Sc. & A.H informed the house that Department of Animal Husbandry declined to nominate the in-service Govt. nominees for pursing B.V.Sc. & A.H programme; and therefore, such seats should be reallocated to appropriate category. The Registrar informed that as per existing regulations of the University the seats lying vacant under any category shall

be filled from NRI/NRIs sponsored category. The matter was deliberated and discussed in the meeting and the following resolution was adopted:-

"Resolved that the 04 seats reserved for In-service-Govt. Nominee in B.V.Sc.& A.H programme shall be filled from self financing (Domicile) category".

3. **Affiliation to Diploma course in Animal Husbandry course**

Dean, F.V.Sc. & A.H. appraised the house that Department of Animal Husbandry runs a one year Diploma in Animal Husbandry Course for in-service candidates in Belicharana Institute, Jammu. The Director, Animal Husbandry approached the University for affiliation of one year diploma course with the University. The course will be run in the Institute of Animal Husbandry Bari Brahmana, however; the academic calendar, syllabus, evaluation, paper setting and guest lecturers may be done by the University. The Hon'ble Vice-Chancellor pointed out that Dean, F.V.Sc. &. A.H. shall frame a committee to study the proposal and submit the report.

4. **Institution of B.Sc. (Hons.) Horticulture programme.**

Head, Division of Fruit Science informed the house that horticulture sector contributes immensely in the economy of UT of Jammu and Kashmir and there is huge demand of institution of B.Sc. (Hons.) Horticulture programme. The house deliberated up on the issue and the following resolution was adopted.

"Resolved the institution of B.Sc. (Hons.) Horticulture Programme is adopted from the academic session 2021-22 and course curriculum annexed at annexure-V be approved".

JP Sharma.

Dr. Jag Paul Sharma
Member Secretary

Approved

Hon'ble Vice Chancellor
SKUAST-Jammu

Annexure - I

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Jammu

LIST OF PARTICIPANTS-21st MEETING OF ACADEMIC COUNCIL

Date: 25th of November, 2020

Venue: Conference Hall
SKUAST-Jammu, Chatha

Participants Record

1.	Prof. J.P. Sharma, Hon'ble Vice-Chancellor	Ex-Officio Chairman
2.	Dr. S.K.Gupta, Director Education	Member
3.	Prof. R.K.Gupta, Director Research	Member
4.	Prof. S.K Gupta, Director Extension	Member
5.	Sh. Rajesh Talwar, Registrar	Member Secretary
6.	Dr. Deepak Kher, Director Planning & Monitoring	Member
7.	Prof. S K Gupta, I/c University Librarian	Member
8.	Dr. J.P Sharma, ACHR, Udheywalla	Member
9.	Dr. D.P. Abrol, Dean, FoA, Chatha	Member
10.	Dr. S. E. H. Rizvi Dean, F.B.Sc., Chatha .	Member
11.	Prof. M S Bhadwal, Dean, F.V.Sc. & A.H., R.S.Pura	Member
12.	Dr. R.K. Salgotra Coordinator School of Biotechnology	Member
13.	Dr. B.C.Sharma Head, Division of Agronomy	Member
14.	Dr. Hafeez Ahmed Head, Division of Entomology	Member

15.	Dr. S.K Singh, Head, Division of Plant Pathology	Member
16.	Dr. R.K. Gupta, Head, Division of Sericulture	Member
17.	Dr. Jagmohan Singh, Prof. Division of Food Science and Technology	Member
18.	Dr . Amit Jasrotia, Head, Division of Fruit Science	Member
19.	Prof. R.K. Gupta, Head, Division of Vegetable Science & Floriculture	Member
20.	Dr. S.K.Gupta Head, Division of Genetics and Plant Breeding	Member
21.	Dr. Rakesh Nanda, Head, Division of Agril. Extension Education	Member
22.	Dr. Jyoti Kachroo, Head, Division of Economics and ABM	Member
23.	Dr. L M Gupta, Head, Division of Agro-Forestry	Member
24.	Dr. Sanjay Khar, Prof., Division of Agril. Engineering	Member
25.	Dr. Vikas Sharma, Head, Division of Soil Science and Agril. Chemistry	Member
26.	Dr. Manish Kumar Sharma, Head, Division of Statistics and Computer Science	Member
27.	Dr. Jonali Devi, Head Division of Vety. Physiology & Biochemistry	Member
28.	Dr. Nawab Nashiruddullah , Head, Division of Vety. Pathology	Member
29.	Dr. Rajesh Katoch, Head, Division of Vety. Parasitology	Member
30.	Dr. A.K Gupta, Head, Division of Vety. Pharmacology and Toxicology	Member
31.	Dr. M. A. Malik, Head, Division of Vety. Public Health and Epidemiology	Member
32.	Dr. Shalini Suri, Head, Division of Vety. Anatomy	Member

33.	Dr. Sunil Kumar , Head, Division of Vety. Livestock Products Technology	Member
34.	Dr. Jasvinder Singh Soodan, Head, Division of Teaching Veterinary Clinical Complex	Member
35.	Dr. Asma Khan, Head, Division of Livestock Production and Management	Member
36.	Dr. Utsav Sharma, Head, Division of Vety. Gynaecology and Obstetrics.	Member
37.	Dr. H.R.Bhardwaj, Head, Division of Vety. Surgery and Radiology	Member
38.	Dr. R.K. Sharma, Head, Division of Animal Nutrition	Member
39.	Dr. R.K. Taggar, Head, Division of Animal Breeding and Genetics	Member
40.	Dr. V S Wazir Division of Vety. Microbiology	Member
41.	Prof. Rajinder Peshin, Agricultural Extension Education	Member
42.	Dr. Kamal Sharma , Professor & Head, Division of Veterinary Anatomy	Member
43.	Dr. Sushil Kumar Gupta I/c UniversiExamination Cell	Member
44.	Dr. Amrish Vaid , Nodal Officer, Mega Seed	Member
45.	Dr. Berjeshwar Singh Asstt. Prof. Microbiology	Member

Annexure - II

Course Curriculum

Course Schedule for Ph.D (Agri Business Management)

Minimum Credit requirements:

Particulars	Credit Hrs.
Major	15
Minor	08
Supporting	05
Seminar	02
Research	45
Total Credits	**75**
Compulsory non-Credit Courses (from PGS 501 to PGS 506, if not studied at Master's Level)	**06**

Major:

Core Courses:

Course No.	Course title	Credit Hrs.
ABM 601	Econometrics for Agri Business	2+1
ABM 602	Communication for Management Teachers	0+2
ABM 603	Advanced Financial Management	1+1
ABM 604	Entrepreneurship in Agribusiness	1+1
ABM 605	Advanced Agribusiness Management	2+1
ABM 606	Advances in Marketing Management	1+1

Optional Courses:

Course No.	Course title	Credit Hrs.
ABM 607	Business Economics	2+1
ABM 608	Advanced Quantitative Analysis	1+1
ABM 609	Organizational process and dynamics	2+0
ABM 610	Pedagogy in Management	1+1
ABM 611	Marketing Strategy – I	2+1
ABM 612	Marketing Strategy – II	2+1
ABM 613	Commodity Market and Supply Chain Management	2+1
ABM 614	Advanced Operations Management	2+1
ABM 615	Advanced Financial Services	2+1

ABM 616	Corporate Finance-I	2+1
ABM 617	Corporate Finance-II	2+1
ABM 618	Strategic Human Resource Management	2+1
ABM 619	Behavioral Sciences	2+1
ABM 620	Cross Cultural Management	2+1

Minor:

The student's advisory committee will decide about the minor course(s) from the other disciplines as required.

Supporting Courses:

Course No.	Course title	Credit Hrs.
STAT 506	MULTIVARIATE ANALYSIS	2+1
STAT 513	OPTIMIZATION TECHNIQUES	1+1

Seminar:

Course No.	Course title	Credit Hrs.
ABM 691	DOCTORAL SEMINAR – I	1+0
ABM 692	DOCTORAL SEMINAR – II	1+0

Research:

Course No.	Course title	Credit Hrs.
ABM 699	DOCTORAL RESEARCH	45

Compulsory Non-Credit Courses (if not studied at Master's level):

Course No.	Course title	Credit Hrs.
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATION SKILLS	0+1
PGS 503	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504 (e-course)	BASIC CONCEPT IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-course)	DISASTER MANAGEMENT	1+0

Deficiency Courses: The Compulsory deficiency courses for the Non MBA(ABM) or MBA(ABM) for other institutions (who have not studied the following courses) degree holders are as under:

(Non-Credit Courses)

S.No.	Course No.	Course Title	Credit Hrs.
1.	ABM 512	Agri-Business Environment & Policy	2+0
2.	ABM 530	Agri Supply Chain Management	2+0
3.	ABM 533	Agricultural Marketing Management	2+0
4.	ABM 534	Farm Business Management	2+0
5.	ABM 538	Commodity Markets and Futures Trading	2+0

As discussed with Head, Division of Statistics & Computer Sciences ABM 601, ABM 608, ABM 614, STAT 506, STAT 513 will be taught by Division of Agricultural Economics & ABM in collaboration with Division of Statistics & Computer Sciences.

Major (Core courses):

ABM 601 : ECONOMETRICS FOR AGRI BUSINESS (2+1)

Need of the course: The course is mainly designed to solid data base analysis of market and policy variables to back up their business strategies. The emphasis will be given on application rather than theoretical details.

Pedagogy: lectures, discussion, application based assignments and projects.

Text book: Basic Econometrics, McGraw-Hill Company.

Syllabus:

Introduction: Correlation theory, Basic concept of regression analysis, assumptions of regression model, theory of OLS, properties of least square estimates, maximum likelihood, hypothesis testing, interval estimation, prediction in linear regression model. Hetero-skedasticity and autocorrelation, multi-collinearity, specification errors, selection of regressors, dummy variables, autoregressive and distributed models. Set of regression equations, causality and simultaneity: application. Nature of dummy variables – Dummy variable approach to compare two regressions – Interaction effects – Use of dependent dummy variables in seasonal analysis - Linear Probability Model – Logit - Probit - Tobit models.

Simultaneous equation model, basic rationale, consequences of simultaneous relations, identification problems, conditions of identifications, indirect least square, two stage least square, K-class estimators, limited informatics and full information maximum likelihood methods, three stage least square, generalized least square, recursive models, SURE models, mixed estimation methods, use of instrumental variables, pooling of cross sections and time series data, time series data, principle of component methods.

PRACTICAL

Single equation two variable model specification and estimation - hypothesis testing- transformations of functional forms and OLS application-estimation of multiple regression model - hypothesis testing - testing and correcting specification errors - testing and managing Multicollinearity - testing and managing heteroscedasticity - testing and managing autocorrelation - estimation of regressions with dummy variables - estimation of regression with limited dependent variable - identification of equations in simultaneous equation systems.

ABM 602: COMMUNICATION FOR MANAGEMENT TEACHERS (0+2)

Course Objective

Communication in management education is not limited to classroom teaching. There are lots of innovative techniques to make teaching and learning interesting, practical and effective. There are various researches are done for methodological and effectiveness aspects. This course will be dealt understanding all the methods of communication for management teaching in learning by doing method and presenting the various researches done in this field.

Course Outline

1. Management education : Action gaps in education and latest developments and required skills
2. Communication: Active listening, group communication, Language process
3. Presentation on readings- recorded and graded: Oral presentation & computer assisted presentations
4. Theory and techniques: Didacticism, Group work & discussion method, Simulation, facilitation skills and styles for experiential learning
5. Emotional perspective in teaching
6. Learning in management education: Experiential learning, Action Learning, Group learning
7. Simulation and games, Role Play
8. Teaching and learning through Electronic Media
9. Case method of teaching: Writing a case and teaching note
10. Critiquing a research article
11. Literature review

ABM 603: Advanced Financial Management

THEORY

Unit I: Financial Functions and Decisions Financial Function and Objective of the firm, Market Efficiency (weak and strong form) and Strategic Financial Management - Financial Markets: Capital markets, money market, derivatives (futures and options) - Corporate Investment Decision and capital rationing.

Unit II: Capital Structure and Cost of Capital Capital Structure: equity (rights, bonus, split and buy back), preference shares, debentures and term loans. Sources of Funds: owner's fund and outsider's fund, Long- and short-term finance implications (debt and equity) and Cost of Capital. Leverage: Operational and financial leverage. Theory of capital structure: Net Income approach, Net Operating Income approach, Miller and Modi-gillani, Pecking Order Theory.

Unit III: Working capital Management and risk and return Managing the Working Capital. Components of Working Capital and its management. Risk and Return - Hedge Funds, Private Equity (PE investors) and Channel Financing.

PRACTICAL

Indian Financial System and Regulatory Issues, Financial Analysis, Cash flow projection and evaluation techniques, Calculation of Weighted Average Cost of Capital (WACC), Valuation of equity shares, preference shares, Valuation of debentures and bonds, convertible securities. Approaches to valuations – Earnings, Dividend growth model, Theory of capital structure - Net Income approach, Theory of capital structure – Net Operating Income approach, Measurement of risk in the Small and the Large Firms.

ABM 604: Entrepreneurship in Agribusiness (1+1)

THEORY

Unit 1 - Theories of Entrepreneurship Theories of Entrepreneurship: Innovation Theory by Schumpeter and Imitating Entrepreneur Theory of Hoselitz, Theory of High Achievement by McClelland, X-Efficiency Theory by Liebenstein, Theory of Profit by Knight, Behavioural Approach Theory, Spill Over theory, Entrepreneurial Learning, Heuristics and Venture creation theory, Theory of Social change by Everett Hagen.

Unit II - Innovation in Entrepreneurship and Intrapreneuship Innovation in entrepreneurship - concepts, principles, sources of Innovation opportunities and entrepreneurship strategies. Intrapreneurship – concepts, differnece between intrapreneurship and enterpreneurship, process, dimensions, barriers and intrapreneurship organisation.

Unit III – Social Entrepreneurship and Public policy Social enterpreneurship – charateristics, scope, objectives and principles , models, process and its impact. Government Policy for MSMEs.

PRACTICALS

Measurement of entrepreneurship, competencies and orientation. Analysis of entrepreneurial behavior and factors influencing entrepreneurship. Entrepreneurship - recent trends and performance analysis. Business Incubators – models and performance analysis. Cluster approach in the entrepreneurial growth and development. Business plans for firms in different life cycle stages. Social Cost Benefit Analysis. Social Return on Investment of Social Entrepreneurship. Public and Private sectors Entrepreneurial Devepoment programmes.

ABM 605: Advanced Agribusiness Management (2+1)

THEORY

Unit I– Overview of Agribusiness Management Agribusiness in India – Status, Agro based industries – role and contribution to agribusiness, Global Trends, Emerging business models, Opportunities and Challenges, Strategic thinking in agribusiness.

Unit II – Agribusiness Sectors and Commodity markets Status and performance of Important Agribusiness Sectors – Seed, Fertilizer, Agrochemicals, Farm Machinery and Implements, Irrigation equipment. Agriculture based service industry. Food and Agro Processing sectors– overview and issues. Food grain markets – Commodity Market Analysis.

Unit III – Logistics and SCM Strategic sourcing – Contract buying, retail buying, state and institutional purchasing, international buying, make or buy, negotiations, value analysis – measuring purchasing performance. Quality Management – 5S, Kaizen, Seven QC tools. Logistics – Packaging, Transportation, Warehousing, Cold Chain Warehousing. Supply Chain Management in agribusiness. Value Chain Analysis.

Unit IV –Exports, Imports and Government Regulations Exports and Imports of agricultural commodities – Government policies on export and import - WTO regulations related to agribusiness. Government intervention and policies for agribusiness development, Public private partnership models.

ABM 606: Advances in Marketing Management (1+1)

Theory

Unit I –Emerging markets Low income markets/BOP-Nature, product and services-Market analysis-Consumer characteristics-Marketing strategy.

Unit II- Services marketing Service marketing models-service marketing mix-consumer behaviour and organizational behaviour in services-Importance of services in agricultural sector.

Unit III- Social marketing Social marketing theories-social marketing opportunities in agricultural sector-marketing strategy – assessing impact of social marketing programs Practical BOP Market analysis. Marketing communication for BoP. Service marketing models in agricultural sector. Importance of consumer behaviour and organizational behaviour in services.

Service marketing models in agricultural sector. Social marketing models, strategies and Evaluating social marketing programs and policies.

Optional Courses:

ABM 607: Business Economics (2+1)

THEORY

UNIT – I Business Economics and Markets Business Objectives-Profit maximization, Sales revenue maximization, Williamson's managerial Utility Model. Market Performance in Perfect competition and Monopoly. Firms Decision making over time - Efficiency, Surplus and Size.The monopolist and Producer Surplus, Non Surplus approach to Economic efficiency. Market Structure and Market Power -Measurement, Problems - Non Cost determinants of market Structure. Industry - Network Externalities, Role of government externalities.

UNIT – II Theory of Consumption, Production and Costs Indifference analysis, marginal utility theory.Behavioral consumer theory - consumer preference, increasing entropy, product life cycle, purchasing decisions of business. Production Functions, Optimal choice of factors, laws of production -Total, average and Marginal Product. Theory of production-short run and long run, Returns to Scale. Short run and Long run theory of costs, costs and the multiproduct firm, Economies of scale and scope, Learning curves and X inefficiency and Costs.

UNIT – III Pricing decisions, Profit and Growth of Firms Firms' pricing decision – perfect competition, monopolistic competition, oligopoly, Cournot, Bertrand models, collusive oligopoly-cartels. Game theory - Non Zero Sum game.Dominant firm pricing and consumer surplus. Price discrimination. Baumol's sales growth model. Boundaries of the firm's growth - Transaction cost approach-Information, Imperfect markets and transaction costs.

UNIT – IV Macro environment of Business Measurement of GDP - Keynesian cross model of the economy- consumption, Investment, government expenditure. Aggregate Demand – Aggregate Supply model. Business Cycles. Fiscal and Monetary policy.

PRACTICAL

Elasticity and business applications - Derivation of demand and supply functions - Producer and consumer surplus and its business implications - Estimation of production function - Least cost combination - derivation of cost curves from production function - Equilibrium prices under different market conditions – Monopoly, Monopolistic competition, Oligopoly and cartels - Computation of factor prices and factor shares - Analysis of trends in national income and Inflation.

ABM 608: Advanced Quantitative Analysis (1+1)

THEORY

Unit I – Descriptive statistics, Exploratory data analysis, Correlation from grouped data, Biserial correlation, Rank correlation and testing , Multiple & partial correlation, Regression Analysis with properties , concept of nonlinear regression, fitting of Quadratic, Exponential and power curves, Economic and optimal doses, Sampling techniques applied in management, Hypothesis testing, t test, f test and chi square test with application, Non – Parametric tests- sign, wilcoxon, Mann-Whitney, U test, Median test, Kvinskal, Wallis test, Friedman two way ANOVA.

Unit II - Production Functions and Supply response models Cobb-Douglas, Quadratic, Transcendental, Trans-log Production functions, deterministic frontier and stochastic frontier productions, Data envelopment analysis (DEA) application in management studies. Supply response models: Autoregressive and Distributed - Lag Models, Markov chains.

Unit III - Time Series Analysis Simple descriptive techniques, trend, seasonality, the correlogram. Probability models for time series: stationarity, co-integration. Moving average (MA), Autoregressive (AR), ARMA and ARIMA models. Estimating the autocorrelation function and fitting ARIMA models. Introduction to vector auto regression (VAR).

PRACTICAL

t test, f test, chi square test, Hypothesis testing, U test, Median test, Wallis test, Moving average (MA), Autoregressive (AR), ARMA and ARIMA models, Lag Models, Markov chains, Non – Parametric tests- sign, wilcoxon, Mann- Whitney, Non – Parametric tests, Markov chains, Probability models for time series Cobb-Douglas, Quadratic, Transcendental, Trans-log Production functions, Deterministic frontier and Stoshastic Frontier Productions, Data Evaluation analysis .

ABM 609: Organizational Process and Dynamics (2+0)

Theory

UNIT I–Organizational effectiveness Organizational process – approaches to organizational process - Organizational effectiveness- Models of organizational effectiveness- Approaches to organizational effectiveness.

UNIT II - Understanding Behaviour in Organizations Group dynamics,Group development process, group decision making, Wringleman effect -Team building models, high performance teams- perspective theories inleadershipand -NeuroLinguistic Programming.

Unit III Organizational psychodynamics Organizational psychodynamics – Open system and psychoanalytical perspective of an organization- Psychodynamics of work – relationship between intrapsychic structure and organizational structure.

UNIT IV - Understanding change Psychological injuries of work -Social defence- bureaucratic culture and its limits -Concept of change,Lewin's change process,Schein's psychological safety – Organizational change, and models- Change agents.

ABM 610: Pedagogy in Management (1+1)

Theory

UNIT I – Case methods and Procedures Origin – Case method – Categories of cases – Methods of using cases – Case writing Procedures.

UNIT II – Case Analysis Written Analysis and Communication - Comparison with conventional method – Merits and Demerits of case study method of teaching.

UNIT III – Role play and other pedagogical tools Role play – Simulation and Computer Aided instructions – Focus Group Discussion – Rapid Appraisal Techniques and PRA – Educational Psychology Practical Exercises on Case administration, Case writing and preparation of teaching notes - Exercise on Role play - Use of Simulation and Computer aided instructions - Exercise on Focus Group Discussion –PRA.

ABM 611: Marketing Strategy – I (2+1)

THEORY

Unit I – Market strategy Strategic Marketing–Developing Competitive Advantage and Strategic Focus - Segmentation and Target Marketing.

Unit II – Product Setting product Strategy – Product life cycle and competitive strategies – New product strategy - Branding – Positioning.

Unit III – Pricing Strategies Strategic Role of Price - Analyzing the Pricing Situation - Selecting the Pricing Strategy - Determining Specific Prices and Policies.

Unit IV – Distribution and Promotion strategies Channel strategy - Managing the channel of distribution – International channels- Marketing Communications Mix-Communication models-Developing Marketing Communications - Promotion Strategy – Advertising strategies – Sales promotion strategies.

PRACTICAL

Marketing strategy - Situational analysis – positioning strategies of food products – Perceptual mapping - market segmentation and target market strategies for food products - market related messages for agribusiness - Product life cycle and marketing strategies - game theory in marketing strategy analysis - Effectiveness of advertisements and sales promotion activities - Marketing Communication analysis.

ABM 612: Marketing Strategy - II (2+1)

THEORY

Unit I – Rural marketing Rural market structure – Perspectives of rural market- Challenges in Rural Marketing and strategy - Rural research.

Unit II – Retailing Consumer Choice and Shopping Strategies: Retail formats and strategies, Evaluating retail strategies and identifying critical success factors (CSFs): Store efficiency. Retail space and format planning: In-store customer behavior -optimizing space and store performance.

Unit III – Internationalization International Retailing: expansion - internationalization process- Entry Behavior, e-Retailing: nature, atmospheric qualities of e-Retailing, Supply Chain Management and Retailer Performance: supply chain partners to create superior value and competitive advantages in the marketplace.

Unit IV – Strategic Customer Relationship Management Developing a CRM Strategy - Value Creation Process - CRM and Strategic Marketing – Marketing performance measurement.

PRACTICAL

Rural market structure - Communication models – Customer relationship management – CRM in agribusiness firms - strategies of firms for diffusion of Innovation in rural - Market performance measurements for agribusiness firms - store efficiency - in-store customer behavior - online atmospheric cues - SCM recent trends and SCM partners and retailers performance improvements.

ABM 613: Commodity Market and Supply Chain Management (2+1)

THEROY

Unit I - Commodity Market Analysis Commodity Market Analysis – Rice, Wheat, Spices, Cotton, Sugar, Palmolein, Turmeric, Groundnut oil, Maize – Futures and Option market in agriculture- Seasonal commodity patterns. Risk management in agricultural commodity markets - Structural Models of Commodity Prices.

Unit II- Logistics Management Logistics in operation - Performance of logistics Function, Integrated Logistics management, Third Party Alliance, Multimodal Transport System in India, Warehousing operations - Third Party Logistics - 4PL service providers.

Unit III - Supply Chain Management Supply Chain Management (SCM) - Metrics/Drivers and Obstacles - SCM Networks - Distribution network - SC Inventories - Inventory planning with known and uncertain demand - Coordination in SCM - Bullwhip effect - Green and Global Supply Chains.

Unit IV - Performance Measurement and Information Technology Performance modeling of supply chains using different techniques - Mathematical programming models for supply chain

planning, design, and optimization - Internet-enabled supply chains - e- marketplaces, e-procurement, e-logistics - supply chain automation and integration.

PRACTICAL Commodity markets - Fundamental and Technical Analysis– Logistics Performance Measurement - Bullwhip effect - Mathematical programming models for supply chain planning, design, and optimization - Supply chain integration-Performance of Supply chains-Analysis of Customer satisfaction.

ABM 614: ADVANCED OPERATIONS MANAGEMENT (2+1)

THEORY

UNIT I - Operations Strategy Operations Management – Decisions, Operational Strategy – Framework-Directed, Emergent, Strategic decisions and competitive effects on Structural and infrastructural decisions.Process Strategy – Process Decisions - Structure in Manufacturing and Services.Design and selection– Types, Managerial Challenges, improvement and Performance. Product and service design – Process– Process Layouts.

UNIT II - Strategic Sourcing Resource Planning - MRP. Inventory planning-customer service-cost policy –operational performance.Strategic Sourcing - Operational and Strategic considerations.Choice ofinventory model - Single period (News Vendor model) -Normal distribution-choosing an order quantity- Multi-period models.

UNIT III - Quality Systems Quality - Customer's and Producer's Perspective -Dimensions of Quality for Manufactured Products and Services - Costs of quality. Quality Management Systems - TQM, Kaizen, Quality control circles, 5-S Program, Poka-Yoke, Taguchi Quality Engineering.

UNIT IV - Lean Management Lean Systems- Lean techniques, Lean Production Total Productive Maintenance -Supplier Networks - Scheduling – Techniques, Managing queues, Waiting Line Management. Constraint Management–Theory of Constraints, Focusing Process, Business Process Analytics.

PRACTICAL

Analysis of Operational Performance - Designing Products and Processes - Application of QFD in New Product Development - Bottleneck analysis - Tools for capacity planning - Project Management Techniques - Deterministic and Probabilistic Inventory Control Models - Quality Management Tools. Business Process mapping Charts.

ABM 615: Advanced Financial Services (2+1)

THEORY

Unit I - Financial services in India Financial services – Concept, Nature, Financial services industry in India, Banking system-RBI- Commercial Bank, NABARD-Cooperatives - Priority sector services - Micro credit –SHGs- Hi-tech Banking- Payment systems and Electronic

banking- Risk management in banks – sources Financial instruments and characteristics of financial instruments in terms of Liquidity, Maturity, Safety and Yield.

Unit II - Non Banking Financial Institutions and Credit Programmes Non-banking financial institutions (NBFI) – Definition and Structure- Types of activities of NBFCs. Factoring – Mechanism, factoring vs banking - Forms, benefits and problems of factoring - Forfeiting in India. Outline of subsidy-linked credit programmes - Special credit programmes - KCC scheme, Financing of Agriclinics/Agribusiness Centres etc. and the Differential Rate of Interest (DRI) scheme- New Trends in Financing of Working Capital by Banks- Prospect theory.

Unit III - Credit rating services and Venture Capital Financing Credit rating services in India - Credit rating methodologies and revisions - SEBI and credit rating - Evolution of venture capital finance and its advantages - Venture capital investment process and forms of Venture capital assistance - Securitization : Process and mechanism.

Unit IV - Depository services and Insurance Depository system – Participants and mechanism, Depository services in India- Review of Mutual Fund Industry in India. IRDA – Regulations, Insurance councils - Reinsurance and Bancassurance. Types of insurance – life and non-life (General, Health and Crop) insurance - Risk management in insurance-insurance evaluation and management process

PRACTICAL

Analyzing bank's financial statements - Cash management and demand forecasting in ATMs - Case study on Innovations in products and services in Banking - Exercise on credit appraisal - Case study on credit monitoring and rehabilitation - NBFCs performance review - Review of leasing industry - Review of factoring industry in India - Review of Merchant banking - Performance measure of mutual fund and mutual fund industry in India - Review of Credit Rating Industry in India - Review of Insurance industry in India - Crop Insurance schemes in India - Stock broking and custodial services - Registrars and share transfer agents and credit card services. Researchable issues in financial services.

ABM 616: CORPORATE FINANCE – I (2+1)

THEORY

Unit I - Working Capital Management An overview of Corporate finance, functions and goals - Designing capital structure - Cash conversion cycle- funding requirements, management strategies - Theories of Trade Credit-I - Theories of Trade Credit –II - Accounts receivable management-credit selection and standards - Accounts receivable management-credit terms an monitoring - Common techniques for managing inventory - Management of liquidity, Budgeting and its types.

Unit II - Management of debt and Corporate Restructuring Management of bad debts by PSU (banks), Management Sick Units, Corporate Restructuring methods - Financial Restructuring –

Mergers and Acquisition - Rationale, Types - Theories of Mergers - Regulation of Mergers and Takeovers in India - Financing techniques in mergers.

Unit III - Business valuation and Business failure Business valuation concepts - Methods of business valuation - Financial distress and its consequences - Business failure-types, causes and mitigations.

Unit IV - International Financial Management International Financial Management – Importance of Basel, Basel I, II & III and its serious - Foreign Exchange Market –Function and Regulation - Financing International operations.

PRACTICAL

Financial Environment of business - Financial statement analysis - Predicting Accounts Receivables behaviour – Markov Process Approach - Measurement of Liquidity - Cash conversion cycle: Estimation - Cash Management Models – Certainty and Uncertainty model. Valuation of business approach – asset based and earnings based approach, Market value based and fair value based Market Value Added (MVA) and Economic Value Added (EVA).

ABM 617: CORPORATE FINANCE – II (2+1)

THEORY

Unit I: Equity capital mobilization and equity trading The Role of Security Markets in Economy - The Organization and Mechanics of Indian Security Markets - Types of Security Markets and their Functions - Methods of raising finance- IPOs, FPOs, private placement – Futures and Options- Call option, Put option, and share - Determinants of option value - Stock valuation – common and preferred stock - Efficient Market Hypothesis.

Unit II: Dividends- Concepts, types - Dividend Policies - Factors Affecting Dividend Decisions of Firms, Limitations on Dividend payment - Dividend Theory- Walter's model, Gordon's model.

Unit III: Hiring and leasing Hire purchase act 1972, Legal and tax aspects, accounting and financial evaluation. Hire purchase finance and installment payment, rights of hiring and. Leasing -types, lease vs purchase decision - Effect of leasing on future financing.

Unit IV: Risk and return Risk and return trade-off - Portfolio Management – Capital Asset Pricing Model (CAPM), Markowitz Portfolio Theory - Arbitrage Pricing Theory (APT), Technical and Fundamental analysis of Capital Markets.

PRACTICAL

Preparation of budget I & II - Performance measurements of Portfolio - Credit Scoring – Altman "Z" score approach - Risk and Return: estimation of Alpha & Beta - Sharpe single index model - Binomial model for option valuation - Black scholes option pricing model - Common Stock valuation – constant growth model, variable growth model.

ABM 618: Strategic Human Resource Management (2+1)

THEORY

Unit I – Human Resource Management Evolution of HRM – Growth of HRM in the new Millennium – Models of HRM - Impact of technology on HRM – Strategic HRM and competitive advantage - Nature and resource based view of strategic human resource management - Strategic impact of HR.

Unit II - Talent management and Outsourcing Talent management, process and developing a talent management strategy- Designing high performance jobs - HR outsourcing and its impact on human resource practices.

Unit III - Training and career development Training need assessment – Evaluation methods of training –Recent trends in training - Management development - Career development – planning and development process — Management of career paths.

Unit IV - Performance Management and international working Characteristics and components of high performance work systems – Human performance technology, development and models – HR valuation — Dimensions of performance – Performance counseling – Competency mapping- Flexibility and work life balance - Global assignment cycle – Managing diversity in international working - HR practices in cross border mergers and acquisitions

PRACTICAL

Application of HR forecasting techniques. Testing the reliability and validity of psychometric tests. Training needs assessment. Evaluation methods of training. Application of Job evaluation methods. Designing effective performance appraisal system. Developing a competency model. Establishing and fixing Compensation. Valuation of human capital by Levy& Schwartz model. Tackling union issues- case studies.

ABM 619: Behavioral Sciences (2+1)

THEORY

Unit I - Learning and Creativity Importance, and Models of Organizational Learning - Kolbs learning cycle and its applications Intelligence approaches, theories, and measurement - Problem solving characteristics of difficult problems and techniques of problem solving.

Unit II - Perception, attitudes and values Attention process and application- Types of memory and models of memory, Mnemonics, concept and application - Job attitudes, types and measurement- Values, cross cultural issues, personal values, impact of personal values in a business setting.

Unit III - Personality theories, Use of personality tests in selection process, use of personality variables in work setting, Job conditions and personality and personality development - concept,

models and applications of emotional intelligence- History, cycle and models of Knowledge management.

Unit IV - Communication and Transactional Analysis Organizational communication and its models- Transactional analysis and ego states, Games in Transactional analysis, Life positions and scripts-Counseling, basics, types of counseling and process of counseling - Mentoring, mentoring culture, Mentoring process, Mentoring styles, qualities of a good mentor- Negotiation, approaches to negotiation, negotiation techniques &implications for managers and negotiators.

PRACTICAL

Kolbs learning cycle, Types and measurement of job attitudes, Personality assessment, Emotional intelligence measurement, Knowledge management, Organizational communication, Transactional analysis, Counselling, Mentoring, Negotiation.

ABM 620: Cross Cultural Management (2+1)

THEORY

Unit I –Cultural frameworks Concepts in cross cultural management- Determinants of cultural identity-Frame work for mapping the culture - Geert Hoefstede, Clyde Cluckhohn, T.E Hall and their comparison – Culture and behavior link.

Unit II- Dimensions of culture in Business Determinants of culture-Cultural dimensions in the business across the nations- Influence of national culture on business - Western business culture-Eastern business culture.

Unit III –Cross cultural issues in management Cross cultural dimensions of decision making– Motivation and leadership across cultures- Negotiations across culture – Business communication across cultures.

Unit IV –Global management challenges Cultural issues in global human resource management - Cultural diversity in cross border alliances- Managerial challenges in international assignments– Future challenges in managing culture.

PRACTICAL

Frameworks of culture, Culture and behavior, Eastern business culture, Western business culture, Cross cultural dimensions, Negotiation across culture, Communication across culture, Multicultural work teams, Global management challenges, Research issues in Cross cultural management.

models and applications of emotional intelligence- History, cycle and models of Knowledge management.

Unit IV - Communication and Transactional Analysis Organizational communication and its models- Transactional analysis and ego states, Games in Transactional analysis, Life positions and scripts-Counseling, basics, types of counseling and process of counseling - Mentoring, mentoring culture, Mentoring process, Mentoring styles, qualities of a good mentor- Negotiation, approaches to negotiation, negotiation techniques &implications for managers and negotiators.

PRACTICAL

Kolbs learning cycle, Types and measurement of job attitudes, Personality assessment, Emotional intelligence measurement, Knowledge management, Organizational communication, Transactional analysis, Counselling, Mentoring, Negotiation.

ABM 620: Cross Cultural Management (2+1)

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PRACTICAL

Frameworks of culture, Culture and behavior, Eastern business culture, Western business culture, Cross cultural dimensions, Negotiation across culture, Communication across culture, Multicultural work teams, Global management challenges, Research issues in Cross cultural management.

Doctor of Philosophy (Agri Business Management) Programme: Admission Process

Eligibility: As per university norms

Number of Seats: The intake capacity will be 03 seats.

Admission Procedure: As per the university norms.

(Dr. Jyoti Kachroo)
M.Phil, Ph.D
HEAD
AEABM

Annexure - III

Performa for institution of Ph.D (Floriculture and landscaping)

Major

		18 credits
A.	**Core courses**	**Credit Hours**
	1. FLA-601 ADVANCES IN BREEDING OF FLOWER CROPS	2+1
	2. FLA-602 ADVANCES IN FLOWER PRODUCTION TECHNOLOGY	2+1
	3. FLA-603 ADVANCES IN PROTECTED FLORICULTURE	2+1
	4. FLA-604 ADVANCE IN LANDSCAPE ARCHITECTURE	1+2
	5. FLA-605 ADVANCES IN BIOTECNOLOGY OF FLOWERS	2+1
	6. FLA-606 ADVANCES IN POST HARVEST HANDLING AND VALUE ADDITION OF ORNAMENTAL CROPS	2+1

B. **Minor courses** **08 credits**

To be decided by the students advisory committee from the subjects like Genetics, Plant Breeding, Biotechnology, Plant Pathology, Entomology, Plant Physiology, Biochemistry, Soil Science or any other subject as decided by advisory committee.

C. **Supporting courses** **05 credits**

		Credit hours
D.	FLA- 691 DOCTORAL SEMINAR	2+0
E.	FLA- 699 DOCTORAL RESEARCH	0+45

F. **Compulsory deficiency courses :** To be decided by the advisory committee

Minimum credits requirement for Ph.D (Floriculture and landscaping)

A.	Major courses	- 18 credits
B.	Minor courses	- 08 credits
C.	Supporting courses	- 05 credits
D.	Seminar	- 02 credits
E.	Doctoral research	- 45 credits
Total credit requirement		**-78 credits**

COURSE CONTENT (Syllabus adapted from New and Restructed Post Graduate Carricula and Syllabi, Education Division, ICAR, 2009)

FLA- 601 ADVANCES IN BREEDING OF FLOWER CROPS (2+1)

Theory: Origin and evolution of varieties, distribution; Genetic resources, genetic divergence; Plant introduction, selection and domestication; Inheritance of important characters; Genetic mechanisms associated with flower colour, flower size, doubleness, fragrance and post-harvest life; Plant Variety Protection Act.

Specific objectives of breeding in flower crops; Methods of breeding suitable for seed and vegetatively propagated flower crops; Introduction, selection, polyploidy and mutation breeding in the evolution of new varieties; Exploitation of heterosis, utilization of male sterility, self incompatibility problems and *in vitro* breeding.

Breeding for resistance to biotic and abiotic stresses in flower crops; Specific breeding problems and achievements made in rose, jasmine, chrysanthemum, marigold, tuberose, carnation, gerbera, gladioli and lilium. Specific breeding problems and achievements made in China aster, petunia, dahlia, hibiscus and bougainvillea.

Practical: Description of crops and cultivars; Cataloguing of species and cultivars; floral biology, selfing and crossing; evaluation of hybrid progenies; Induction of mutants; Induction of polyploidy; Screening of plants for biotic and abiotic stresses and environmental pollution; *in-vitro* breeding in flower crops.

Suggested Readings:

Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publications.

Choudhary RC.1993. Introduction to Plant Breeding. Oxford & IBH.

Singh BD.1990. Plant Breeding. Kalyani Publishers.

Singh A.K. 2014. Breeding and Biotechnology of Flowers. Vol. I & II. New India Publishing Agency.

FLA 602 ADVANCES IN FLOWER PRODUCTION TECHNOLOGY (2+1)

Theory: Scope and importance of Commercial flower production; Indian and Global Scenario in cut flower production; Agri Export Zones; cut flower, loose flowers, dry flowers and floral oil trade.

Propagation and multiplication; IPR issues related to propagation of materials

Greenhouse management; Soil/media decontamination techniques; Micro-irrigation; nutrition and fertigation; slow release fertilizers and bio-fertilizers; influence of environmental parameters viz: light, temperature, moisture, humidity and CO_2 on growth and flower regulation.

Flower forcing and year-round flowering through physiological interventions; Chemical regulation: Environmental manipulation; Harvest indices; Harvesting techniques; Post-harvest handling; Pre-cooling, pulsing, packing, marketing; Export potential;.

Production technology of Rose, Carnation, Gladioli, Gerbera, Liliums, Jasmine, Marigold, Tuberose, Chrysanthemum, Tulip and Dahlia.

Floral oil industry, floral concrete production, extraction methods, recent advances.

Practical: Varietal wealth in flower crops; Greenhouse management; Soil decontamination techniques; Micro-irrigation systems; Nutrition and fertigation. Special practices- Pinching, netting, disbudding, defoliation and chemical pruning; Photoperiodic and chemical induction of flowering; Assessing harvest indices; Post-harvest handling; Tissue analysis; Preparation of floral decoratives; case studies; visit to commercial cut flower units.

Suggested Readings:

Bose TK, Maiti RG, Dhua RS and Das P. 1999. Floriculture and Landscaping. Naya Prokash.

Chadha KL and Choudhury B. 1992. Ornamental Horticulture in India. ICAR.

George S and Peter KV. 2008. Plants in a Garden. New India Publ. Agency.

Randhawa G.S. & Mukhopadhyay A. 1986. Floriculture in India. Allied Publishers.

FLA 603 ADVANCES IN PROTECTED AND PRECISION FLORICULTURE (2+1)

Theory: Prospects of protected floriculture in India, growing structures, basic considerations in establishment and operation of green houses, functioning and maintenance. Environmental control systems in greenhouse, containers, substrate culture, soil decontamination techniques.

Water and nutrient management, crop regulation, special horticultural practices under protected cultivation of rose, chrysanthemum, carnation, orchids, anthurium, gerbera, liliums, cut foliage; Harvest indices – harvesting, Post harvest handling, marketing, export.

Precision floriculture: Principles and concepts; Enabling technologies of precision farming; GPS, GIS, Remote sensing, sensors; Variability management in precision farming, mapping, variable rate technology, precision equipments, computers and robotics in precision farming, post-harvest management in floriculture.

Practical: Growing structures, basic considerations in establishment and operation of greenhouses. Environmental control systems in greenhouse, containers and substrate culture, soil decontamination techniques, Crop regulation, special horticultural practices under protected cultivation, postharvest process management of cut flowers.

Suggested Readings:

Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publishers.

Bose TK, Maiti RG, Dhua RS & Das P. 1999. Floriculture and Landscaping. Naya Prokash.

Reddy S, Janakiram B, Balaji T, Kulkarni S, & Misra RL. 2007. Hightech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.

FLA-604 ADVANCES IN LANDSCAPE ARCHITECTURE (1+2)

Theory: History of landscape gardening, Plant identification and selection, Principles and elements of garden design, Garden adornments and enrichment items, surfacing materials and enclosures: Garden styles and types.

Creativity and communication skills for landscape architect, Method of designing a commercial landscape project.

Assessing site and plants adaptability for different locations; Landscape engineering (Topographical survey and designing concept); special techniques in landscaping (water-scaping, hard-scaping, lawn making, topiary styles specializing, bio-aesthetic planning).

Preparation and drawing of site plan; Role of computer aided design (CAD) for developing a garden landscape plan, Use of software for designing (AUTOCAD & ARCHICAD), GIS as a tool for spatial designing.

Contemporary landscaping, Environmental landscaping, Industrial and institutional landscaping, Public and private garden making, landscaping of play ground, Budget analysis/ cost estimation of design. Execution strategies.

Practical: Plant identification, Design making by different garden styles and types. Way of designing a commercial landscape project, visit to model ornamental nursery. Assessing site and plants adaptability for different locations, Topographical survey and designing concept, layout of water garden, lawn making, topiary making, Preparation and drawing of site plan, Hands on computer aided design (CAD) for developing a garden landscape plan. Contemporary landscaping, Environmental landscaping, Industrial and institutional landscaping, Public and private garden making, Project cost estimation.

Suggested Readings:

Bose TK, Maiti RG, Dhua RS & Das, P. 1999. Floriculture and Landscaping. Naya Prokash.

Nambisan KMP. 1992. Design Elements of Landscape Gardening. Oxford & IBH.

Bhattacharjee, S.K. 2004, Landscape Gardening and Design with Plants. Aavishkar Publishers and Distributors, Jaipur, India.

Randhawa, G.S. and Mukopadhyay, A. 1998., Floriculture in India

Ervin, S. and Hasbrouck, H., 2001. Landscape modeling: Digital Techniques for Landscape Visualization. Mc Graw-Hill, New York.

M. Ashraf., A Hand book of landscape- Gardening and environment: Agribusiness publishers, Jodhpur

FLA-605 ADVANCES IN BIOCHEMISTRY AND BIOTECHNOLOGY OF FLOWERS (2+1)

Theory: Biochemistry of flowers: Principle involved in the formation of pigments – chlorophyll, xanthophyll, carotenoids, flavonoids and anthocyanins. Chemistry and importance of secondary metabolites in rose, jasmine, marigold, and tuberose. Economical aspects of plant pigments.

Recent trends in extraction of bio-colours and their value addition and uses, Biochemistry of post harvest life of cut flowers.

Biotechnology: tools, techniques and role in floriculture industry, physical factors and chemical factors influencing the growth and development of plant cell, tissue and organs, cyto-differentiation, organogenesis, somatic embryogenesis.

In vitro lines for biotic and abiotic stress, Meristem culture for disease elimination, production of haploids through anther and pollen culture, embryo and ovule culture, micrografting, wide hybridization and embryo rescue techniques, construction of somatic hybrids and cybrids, regeneration and characterization of hybrids and cybrids, *in vitro* pollination and fertilization, hardening media, techniques and establishment of tissue culture plants in the primary and secondary nursery.

Somoclonal variation and its applications, variability induction through in vitro mutation, development of cell suspension cultures, types and techniques, *in vitro* production of secondary metabolites, role of bioreactors in production of secondary metabolites, quantification and quality analysis of secondary metabolites using HPLC.

Gene cloning, genetic engineering: vectors and methods of transformation, electroporation, particle bombardment, *Agrobacterium* mediated, transgenic plants in flower crops, isolation of DNA, RNA, quantification, Polymerase Chain Reaction for amplification; AGE & PAGE techniques; identification of molecular markers.

DNA fingerprinting technique in economic flower crop varieties, molecular approaches to control ethylene response, improving shelf life, improving resistance for environmental stress, achievements made through bio-technology in flower crops.

Practical: Extraction of flower pigments – xanthophylls, carotenoids and anthocyanins; Plant nutrient stock, growth regulators, media preparation and sterilization; *In vitro* seed germination-callus culture and organ culture; Clonal propagation through Meristem culture, Anther, Pollen, Ovule and Embryo culture, *in vitro* rooting, hardening at primary and secondary nurseries, Project preparation for establishment of low, medium and high cost tissue culture laboratories, DNA isolation from economic flower crop varieties – Quantification and amplification.

Suggested Readings:

Chopra VL & Nasim. 1990. Genetic Engineering and Biotechnology – Concepts, Methods and Applications. Oxford & IBH.

Debnath M. 2005. Tools and Techniques of Biotechnology. Pointer Publ.

Dey PM & Harborne JB. 1997. Plant Biochemistry. 2nd Ed. Academic Press.

Glover MD. 1984. Gene Cloning: The Mechanics of DNA Manipulation. Chapman & Hall.

Goodwin TW & Mercer EI. 2003. Introduction to Plant Biochemistry. CBS.

Keshavachandran R, Nazeem PA, Girija D, John PS & Peter KV. (Eds.). 2007. Recent Trends in Horticultural Biotechnology. Vols. I, II. New India Publishing Agency.

FLA 606 ADVANCES IN POST HARVEST HANDLING AND VALUE ADDITION OF ORNAMENTAL CROPS (2+1)

Theory: Importance and scope of post harvest technology; Post harvest physiological and biochemical changes in ornamental; Maturity indices, harvesting, grading, bunching of cut-flowers; Factors affecting cut-flower longevity; Pretreatments for extending the vase life of cut flowers, pre-cooling, use of preservative solutions, growth regulators and other chemicals; Preparation of cut-flowers for market and transportation; Export requirement; Dutch auctioning system.

Importance, opportunities and prospects of value addition in floriculture; national and global scenario of production and exports, supply chain management.

Dry flower making including pot pourries, their uses and trade; drying methods; Essential oil: extraction methods, uses, sources and trade; aromatherapy; pigment and natural dyes extraction technology: sources, uses and trade.

Pharmaceutical and neutraceutical compounds from flower crops; Floral craft including bouquets, garlands, flower arrangements etc.; tinting (artificial colouring) of flower crops; Women empowerment through value added products making.

Practicals: Maturity indices and harvesting; Grading, sorting, cleaning and preparation for marketing; Studies on vase life of flowers; Dry flower making and floral craft; essential oil extraction technology; Pigment and natural dyes extraction technology; preparation of products likegulkand, rose water, gulroghan, attar, pankhuri; Petal embedded handmade paper making, Tinting (artificial colouring) of flower crops. Visit to flower market and essential oil extraction unit.

Suggested Reference:

Salunke, D.K., Bhatt and Desai., 1990. Post harvest Biotechnology of flowers and ornamental plants.

S.K. Bhattacharjee and L.C. De., 2005. Post harvest technology of flowers and ornamental plants

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Annexure-IV

Detail of Course Curriculum for M.Sc. (Seed Technology)

Courses for UG & PG: (As per ICAR guidelines)

(a) **Post Graduate Courses:**

M.Sc. Programme: M.Sc. degree in Seed Science and technology will be offered by this Division. The curriculum will be spread over four semesters and will cover all courses as per ICAR norms.

(b) **Ph.D. Programme: Spread over six semesters**

Intake Capacity:

Academic programme	Eligibility requirements	Intake capacity in No.
M.Sc.	B.Sc. Agriculture/B.Tech Agri. Engineering/ B.Sc. Biotechnology	05
Ph.D.	M.Sc. Seed Science & Technology/PBG/Agronomy/ Pathology/ Entomology	--

COURSES FOR M.Sc. IN SEED SCIENCE AND TECHNOLOGY

SEED SCIENCE AND TECHNOLOGY

Course Structure

CODE	COURSE TITLE	CREDITS
SST - 501*	Floral Biology, Seed Development & Maturation	1+1
SST - 502*	Principles of Seed Production	2+0
SST - 503*	Seed Production in Field Crops	2+1
SST - 504	Seed Production in Vegetables	2+1
SST - 505	Seed Production in Flower, Medicinal Fruits and Plantation Crops	2+1
SST - 506*	Seed Legislation and Certification	2+1
SST - 507*	Seed Processing and Storage	2+1
SST - 508*	Seed Quality Testing	2+1
SST - 509	Seed Physiology	2+1
SST - 510/	Seed Pathology	2+1
SST - 511 /	Seed Entomology	2+1
SST - 512	Seed Production in Pasture, Forage and Green Manure Crops	2+1
SST - 513	Seed Storage and Deterioration	1+1
SST - 514	Seed Marketing and Management	1+1

SST - 515	Emerging Trends in Seed Quality Enhancemnt	1+1
SST - 516	Data Base Management, Evaluation and Utilization of PGR	2+1
SST-591	Master's Seminar	1+0
SST-599	Master's Research	20

* Compulsory for Master's programme

Course Content for M.Sc. in Seed Science and Technology

SST – 501 FLORAL BIOLOGY, SEED DEVELOPMENT AND MATURATION **1+1**

Theory

Unit I

Floral types, structure and biology in relation to pollination mechanisms; sporogenesis: microsporogenesis and megasporogenesis; gametogenesis - development of male and female gametes and their structures; effect of environmental factors on floral biology.

Unit II

Fertilization – embryo substructure, process, barriers to fertilization, incompatibility and male sterility, factors affecting fertilization.

Unit III

Embryogenesis - development of typical monocot and dicot embryos; endosperm development, modification of food storage structures with reference to crop plants; different types of embryos, endosperm and cotyledons; development and their structure in representative crop plants with reference to food storage; external and internal features of monocot and dicot seed; seed coat structure and development in representative crop plants.

Unit IV

Apomixis – identification, classification, significance and its utilization in different crops for hybrid seed production; Polyembryony - types and significance; haplontic and diplontic sterility, causes of embryo abortion, embryo rescue and synthetic seeds.

Practical

Study of floral biology of monocots and dicots; microsporogenesis and megasporogenesis; study of pollen grains - pollen morphology, pollen germination and pollen sterility; types monocot and dicot embryos; external and internal structures of monocot and dicot seeds; seed coat structure, preparation of seed albums and identification.

Suggested Readings

1. Bhojwani, S. S. and Bhatnagar, S.P., 1999, The Embryology of Angiosperm. Vikas Publ.
2. Black, M., Bewley, D. and Halmer, P., 2006, The Encyclopedia of Seeds:Science, Technology and Uses. CABI. Chhabra, A.K., 2006, Practical Manual of Floral Biology of Crop Plants. Deptt. of Plant Breeding, CCS HAU, Hisar.
3. Copeland, L.O. and McDonald, M.B., 2001, Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
4. Frankel, R. and Galun, E., 1977, Pollination Mechanisms, Reproduction and Plant Breeding. Springer Verlag. 53

SST - 502 PRINCIPLES OF SEED PRODUCTION 2+0

Theory

Unit I

Introduction : Seed as basic input in agriculture; seed development in cultivated plants; seed quality concept and importance of genetic purity in seed production; types of cultivars, their maintenance and factors responsible for deterioration; seed production in self and cross pollinated crops.

Unit II

Mode of pollination and reproduction in crop plants and their modification in relation to hybrid seed production. Principles of hybrid seed production, isolation distance, synchronization of flowering, roguing etc. male sterility and incompatibility system in hybrid seed production, role of pollinators and their management.

Unit III

Seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production – agro climatic requirements and their influence on quality seed production; generation system of seed multiplication; maintenance of Nucleus seed, production of Breeder, Foundation and Certified seed– criteria involved; life span of a variety and causes for its deterioration; certification standards for self and cross pollinated and vegetatively propagated crops.

Unit IV

Hybrid Seed - Methods of development of hybrids; use of male sterility and self-incompatibility and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed production technology of major field crops and vegetables.

Unit V

Planning of seed production for different classes of seeds for self and crosspollinated crops, Seed quality control system and organization, seed village concept; Seed production agencies, seed industry and custom seed production in India.

Suggested Readings

1. Agarwal, R. L., 1997, Seed Technology. 2nd Ed. Oxford & IBH.
2. Chhabra, A. K., 2006, Practical Manual of Floral Biology of Crop Plants. Dept. of Plant Breeding CCS HAU, Hisar.
3. Desai, B.B, 2004, Seeds Handbook. Marcel Dekker.
4. Kelly, A.F., 1988, Seed Production of Agricultural Crops. Longman.
5. McDonald, M.B. Jr., and Copeland, L.O., 1997, Seed Production: Principles and Practices. Chapman & Hall. Musil, A.F., 1967, Identification of Crop and Weed Seeds. Handbook No. 219, USDA, Washington, DC, USA. Poehlman, J.M. and Sleper, D.A., 2006, Breeding Field Crops. Blackwell.
6. Singh, B.D., 2005, Plant Breeding: Principles and Methods. Kalyani. Singhal, N.C., 2003, Hybrid Seed Production in Field Crops. Kalyani. Thompson, J.R., 1979, An Introduction to Seed Technology. Leonard Hill. Tunwar, N.S. and Singh, S.V., 1985, Handbook of Cultivars. CSCB, GOI. 54

SST - 503 SEED PRODUCTION IN FIELD CROPS 2+1

Theory

Unit I

Basic principles in seed production and importance of quality seed. Floral structure, breeding and pollination mechanism in self-pollinated cereals and millets viz, wheat, barley, paddy, etc.

Unit II

Floral structure, breeding and pollination mechanism in cross-pollinated cereals and millets viz maize, sorghum, bajra etc; methods and techniques of quality seed production in cross-pollinated cereals and millets.

Unit III

Floral structure, breeding and pollination mechanism; methods and techniques of seed production in pulses (pigeon pea, chick pea, green-gram, black-gram, field beans, peas etc.).

Unit IV

Floral structure, breeding and pollination mechanism; methods and techniques of seed production in major oil seeds (groundnut, castor, sunflower, safflower, rape and mustard, linseed, sesame etc.).

Unit V

Floral structure, breeding, and pollination mechanism; methods and techniques of seed production in commercial fibers (cotton, jute, mesta etc) and vegetatively propagated crops like sugar cane, potato etc.

Practical

Planning of Seed Production, requirements for different classes of seeds in field crops - Unit area and rate; Seed production in cross pollinated crops with special reference to land,

isolation, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in Cotton, detasseling in Corn, identification of rogues and pollen shedders; Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc.

Suggested Readings

1. Kelly, A.F., 1988, Seed Production of Agricultural Crops. John Wiley.

2. McDonald, M.B. Jr., and Copeland, L.O., 1997, Seed Production: Principles and Practices. Chapman, and Hall. Singhal, N.C., 2003, Hybrid Seed Production in Field Crops. Kalyani.

SST - 504 SEED PRODUCTION IN VEGETABLES 2+1

Theory

Unit I

Introduction; modes of propagation in vegetables. Seed morphology and development in vegetable seeds. Floral biology of these plant species; classification of vegetable crops based on pollination and reproduction behavior; steps in quality seed production; identification of suitable 55 areas/locations for seed production of these crops.

Unit II

Classification based on growth cycle and pollination behavior; methods of seed production; comparison between different methods e.g. seed-to-seed vs. root-to-seed method in radish; seed multiplication ratios in vegetables; pollination mechanisms; sex types, ratios and expression and modification of flowering pattern in cucurbits; nursery raising and transplanting stage.

Unit III

Seed production technology of vegetables viz. solanaceous, cucurbitaceous, leguminous, malvaceous, cole crops, leafy vegetables, root, tuber and bulb crops and spices; harvesting/picking stage and seed extraction in fruit vegetables; clonal propagation and multiplication in tuber crops e.g. Potato, sweet potato, colocasia, tapioca; seed-plot technique in potato tuber seed production; hybrid seed production technology of vegetable crops, TPS (true potato seed) and its production technique; hybrids in vegetables; maintenance of parental lines; use of male sterility and self incompatibility in hybrid seed production, environmental factors related to flowering/bolting in vegetable crops.

Unit IV

Share of vegetable seeds in seed industry; importance and present status of vegetable industry; intellectual property rights and its implications, impact of PVP on growth of seed industry.

Practical

Selection of suitable areas/locations for high quality seed/planting material production; study of floral biology of vegetables, determination of planting ratios for hybrid seed production vegetables; use and maintenance of monoecious line in hybrid seed production of cucumber; exercises on emasculation and pollination; seed extraction methods and their effect

on quality of vegetables; seed production technology of varieties and hybrids in vegetables.

Suggested Readings

1. Agarwal, R.L., 1997, Seed Technology. 2nd Ed. Oxford & IBH.
2. Desai, B.B., Katecha, P.M. and Salunke, D.K.,1997, Seed Hand Book: Biology, Production, Processing and Storage. Marcel Dekker.
3. Desai, B.B., 2004, Seeds Handbook. Marcel Dekker.
4. George, R.A.T., 1980, Vegetable Seed Technology. A Technical Guide toVegetable Seed Production, Processing, Storage and QualityControl. FAO, Rome.
5. Hartman, H.T. and Kester, D.E., 2000, Plant Propagation: Principles and Practices. Prentice Hall.
6. Kelly, A.F. and George, R.A.T. (Eds.)., 1998, Encyclopedia of Seed Production of World Crops.
7. John Wiley and Sons.McDonald, M.B Jr., and Copeland, L.O., 1997, Seed Production of Crops; Principles and Practices. Chapman & Hall.
8. Salunkhe, D.K., Desai, B.B. and Bhat, R.N., 1987, Vegetable and Flower Seed Production. Agricole Publ. Academy.
9. Singh, S.P., 2001, Seed Production of Commercial Vegetables.Agrotech. Singhal, N.C., 2003, Hybrid Seed Production in Field Crops. Kalyani. 56

SST - 505 **SEED PRODUCTION IN FLOWERS, MEDICINAL, FRUITS AND PLANTATION CROPS** **2+1**

Theory

Unit I

Introduction: modes of propagation in fruits, flower and plantation crops. Floral biology of these plant species; classification of medicinal and horticultural crops based on pollination and reproduction behavior; steps in quality seed production; identification of suitable areas/locations for seed production of these crops.

Unit II

Flowers and Medicinal Plants; classification based on growth cycle, reproduction and pollination behavior; nursery requirement, planning and management; technology for quality seed production in important flower species i.e. marigolds, petunias, dahlia, roses, gladiolus, tulips, chrysanthemum etc; development of hybrids and their seed production technology flower plants. Seed production technology of annual medicinal plants viz. isabgol, ashawagandha etc.

Unit III

Fruit and Plantation Crops: role of seed in perennial plant species; classification based on reproduction and pollination behavior; polyembryony and its significance; nursery requirement, planning and management; clonal propagation and multiplication in tropical, sub-tropical and temperate fruits and plantation crops; seed orchards; seed collection, extraction and processing.

Unit IV

IPR issues with special reference to floral and plantation crops.

Practical

Selection of suitable areas/locations for high quality seed/planting material production; study of floral biology of flowers, fruits, medicinal and plantation crops; determination of planting ratios for hybrid seed production in flowers; exercises on emasculation and pollination; seed extraction methods and their effect on quality of fruit; seed production technology of varieties and hybrids; seed collection and extraction in fruit and plantation crops.

Suggested Readings

1. Agarwal, R.L., 1997, Seed Technology. 2nd Ed. Oxford & IBH.
2. Desai, B.B., Katecha, P.M. and Salunke, D.K.,1997, Seed Hand Book: Biology, Production, Processing and Storage. Marcel Dekker.
3. Desai, B.B., 2004, Seeds Handbook. Marcel Dekker.
4. Doijode, S.D., 2001, Seed Storage of Horticultural Crops. CBS
5. George, R.A.T., 1980, Vegetable Seed Technology. A Technical Guide to Vegetable Seed Production, Processing, Storage and Quality Control. FAO, Rome.
6. Hartman, H.T. and Kester, D.E., 2000, Plant Propagation: Principles and Practices.
7. Prentice Hall. ICAR. Hand Book of Horticulture. ICAR Publ. 57
8. Kelly, A.F. and George, R.A.T. (Eds.)., 1998, Encyclopedia of Seed Production of World Crops. John Wiley & Sons.
9. McDonald, M.B Jr., and Copeland, L.O., 1997, Seed Production of Crops: Principles and Practices. Chapman & Hall.
10. Salunkhe, D.K., Desai, B.B. and Bhat, R.N., 1987, Vegetable and Flower Seed Production. Agricole Publ. Academy.
11. Singh, S.P., 2001, Seed Production of Commercial Vegetables.Agrotech.
12. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani.

SST - 506 SEED LEGISLATION AND CERTIFICATION 2+1

Theory

Unit I

Historical development of Seed Industry in India; Seed quality: concept and factors Affecting seed quality during different stages of production, processing and handling; seed Quality control- concept and objectives; Central Seed Certification Board (CSCB).

Unit II

Regulatory mechanisms of seed quality control- organizations involved in seed quality control programmes; seed legislation and seed law enforcement as a mechanism of seed quality control; the Seed Act (1966), Seed Rules (1968), Seed (Control) Order 1983; Essential Commodities Act (1955); Plants, Fruits and Seeds Order (1989); National Seed Development Policy (1988) and EXIM Policy regarding seeds, plant materials; New Seed Bill-2004 etc. Introduction, objectives and relevance of plant quarantine, regulations and plant quarantine set up in India.

Unit III

Seed Certification- history, concept and objectives of seed certification; seed certification agency/organization and staff requirement; legal status and phases of seed certification; formulation, revision

and publication of seed certification standards; Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including GM varieties, field and seed standards; planning and management of seed certification programmes- eligibility of a variety for certification, area assessment, cropping history of the seed field, multiplication system based on limited generation concept, isolation and land requirements etc.

Unit IV

Field Inspection- principles, phases and procedures; reporting and evaluation of observations; pre and post-harvest control tests for genetic purity evaluation (grow-out tests); post harvest inspection and evaluation; seed sampling, testing, labeling, sealing and grant of certificate; types and specifications for tags and labels; maintenance and issuance of certification records and reports; certification fee and other service charges; training and liaison with seed growers. OECD seed certification schemes.

Unit V

Introduction to WTO and IPRs; Plant Variety Protection and its significance; UPOV and its role; DUS testing- principles and applications; essential features of PPV & FR Act, 2001 and related Acts. 58

Practical

General procedure of seed certification ; identification of weed and other crop seeds as per specific crops; field inspection at different stages of a crop and observations recorded on contaminants and reporting of results; inspection and sampling at harvesting/threshing, processing and after processing for seed law enforcement; testing physical purity, germination and moisture; specifications for tags and labels to be used for certification purpose; grow-out tests for pre and post-harvest quality control; visits to regulatory seed testing laboratory, including plant quarantine lab and seed certification agency.

Suggested Readings

1. Agarwal, R.L., 1997, Seed Technology. Oxford & IBH
2. Anonymous, 1992, Legislation on Seeds. NSC Ltd., Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi
3. Nema, N.P., 1986, Principles of Seed Certification and Testing. Allied Publs
4. Tunwar, N.S. and Singh, S.N., 1988, Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

SST - 507 SEED PROCESSING AND STORAGE 2+1

Theory

Unit I

Introduction: Principles of seed processing; methods of seed drying including dehumidification and its impact on seed quality. Relative humidity and equilibrium moisture content of seed; Thumb rules of seed storage; loss of viability in important agricultural and horticultural crops, viability equations and application of nomograph.

Unit II

Seed cleaning equipment and their functions: Preparing seed for processing; functions of scalper debearder, scarifier, huller, seed cleaner and grader. Screen cleaners, specific gravity separator, indented cylinder, velvet-spiral-disc separators, colour sorter, delinting machines; seed blending.

Unit III

Assembly line of processing and storage, receiving, elevating and conveying equipments, plant design and layout, requirements and economic feasibility of seed processing plant.

Unit IV

Seed treatments-methods of seed treatment, seed treating formulations and equipments, seed disinfestations, identification of treated seeds; Packaging: principles, practices and materials; bagging and labeling.

Unit V

Seed storage: Seed drying and storage; drying methods-importance and factors affecting it, changes during storage, concepts and significance of moisture equilibrium, methods of maintaining safe seed moisture content. Methods to minimize the loss of seed vigour and viability; factors influencing storage losses. Storage methods and godown sanitation. Storage structures. Storage problems of recalcitrant seeds and their conservation.

Practical

Operation and handling of mechanical drying equipments; effect of drying temperature and duration on seed germination and storability with particular reference to oil seeds; seed extraction methods; seed processing equipments; seed treating equipments; visit to seed processing plant and commercial controlled and uncontrolled Seed Stores;. seed quality up-gradation; measurement of processing efficiency; seed blending, bag closures; study of orthodox, intermediary and recalcitrant seeds; evaluating seed viability at different RH and temperature levels and packaging materials; prediction of storability by accelerated ageing controlled deterioration tests.

Suggested Readings

1. Agrawal, R.L., 1996, Seed Technology. Oxford Publ.
2. Barton, L.V., 1985, Seed Preservation and Longevity. International Books and Periodicals Supply Service, New Delhi.
3. Hall, C.W., 1966, Drying of Farms Crops. Lyall Book Depot.Justice OL & Bass LN. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.
4. Mathews, R.K., Welch, G.B., Delouche, J.C. and Dougherty, G.M., 1969, Drying Processing and Storage of Corn seed in Tropical and Subtropica Regions. Proc. Am. Agric. Eng. St. Joseph, Mich. Paper No. 69-67.
5. Sahay, K.M. and Singh, K. K., 1991, Unit Operations in Food Engineering.Vikas Publ.
6. Virdi, S.S. and Gregg, B.G., 1970, Principles of Seed Processing. National Seed Corp., New Delhi.

SST - 508 **SEED QUALITY TESTING** **2+1**

Theory

Unit I

Introduction Structure of monocot and dicot seeds; seed quality: Objectives, concepts

and components and their role in seed quality control; instruments, devices and tools used in seed testing. ISTA and its role in seed testing.

Unit II

Seed Sampling: definition, objectives, seed-lot and its size; types of samples; sampling devices; procedure of seed sampling; sampling intensity; methods of preparing composite and submitted samples; sub-sampling techniques, dispatch, receipt and registration of submitted sample in the laboratory, sampling in the seed testing laboratory.

Unit III

Physical Purity: definition, objective and procedure, weight of working samples for physical purity analysis; components of purity analysis and their definitions and criteria; pure seed definitions applicable to specific genera and families; multiple seed Units; general procedure of purity analysis; calculation and reporting of results, prescribed seed purity standards; determination of huskless seeds; determination of weed seed and other seed by number per kilogram; determination of other distinguishable 60 varieties (ODV); determination of test weight and application of heterogeneity test.

Unit IV

Seed moisture content: importance of moisture content; equilibrium moisture content; principles and methods of moisture estimation - types, instruments and devices used; pre-drying and grinding requirements, procedural steps in moisture estimation; calculation and reporting of results.

Unit V

Germination: importance; definitions; requirements for germination, instrument and substrata required; principle and methods of seed germination testing; working sample and choice of method; general procedure for each type of method; duration of test; seedling evaluation; calculation and reporting of results; dormancy: definition, importance, causal mechanisms, types and methods for breaking dormancy.

Unit VI

Viability and Vigour Testing: definition and importance of viability tests; different viability tests; quick viability test (TZ- test) - advantages, principle, preparation of seeds and solutions, procedure, evaluation and calculation of test results. Vigour testing: concept, historical development, definitions, principles and procedures of different methods used for testing vigour.

Unit VII

Genetic purity testing : objective and criteria for genetic purity testing; types of test; laboratory, Growth Chamber and field testing based on seed , seedling and mature plant morphology; principles and procedures of chemical, biochemical and molecular tests.

Unit VIII

Seed health Testing: field and seed standards ; designated diseases, objectionable weeds - significance of seed borne disease vis-a-vis seed quality - seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes.

Unit IX

Testing of GM seeds and trait purity, load of detection (LOD).

Unit X

Preparation and dispatch of seed testing reports; storage of guard samples; application and use of seed standards and tolerances.

Practical

Structure of monocot and dicot seeds of important plant species; identification and handling of instruments used in seed testing laboratory; identification of seeds of weeds and crops; physical purity analysis of samples of different crops; estimation of seed moisture content (oven method); seed dormancy breaking methods requirements for conducting germination test, specifications and proper use of different substrata for germination; seed germination testing in different agri-horticultural crops; seedling evaluation; viability testing by tetrazolium test in different crops; seed and seedling vigour tests applicable in various crops; species & cultivar identification; genetic purity testing by chemical, biochemical and molecular methods; seed health testing for designated diseases, blotter 61 methods, agar method and embryo count methods; testing coated/pelleted seeds.

Suggested Readings

1. Agarwal, R.L., 1997, Seed Technology. Oxford & IBH.
2. Agrawal, P.K. and Dadlani, M.,1992, Techniques in Seed Science and Technology. 2nd Ed. South Asian Publ.
3. Agrawal, P.K. (Ed.)., 1993, Handbook of Seed Testing. Ministry of Agriculture, G.O.I., New Delhi.
4. Copland, L.O. and McDonald, M.B., 1996, Principles of Seed Science and Technology. Kluwer. ISTA., 2006, Seed Testing Manual. ISTA, Switzerland.
5. Martin, C. and Barkley, D., 1961, Seed Identification Manual. Oxford & IBH.
6. Tunwar, N.S. and Singh, S.V., 1988, Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

SST - 509 **SEED PHYSIOLOGY** **1+1**

Theory

Unit I

Physiology of seed development and maturation; chemical composition, synthesis and accumulation of seed reserves, induction of desiccation tolerance, hormonal regulation of seed development.

Unit II

Seed germination; factors affecting germination; role of embryonic axis; growth hormones and enzyme activities, effect of age, size and position of seed on germination. Physiological processes during seed germination; seed respiration, breakdown of stored reserves in seeds, mobilization and interconversion pathways. Seed dormancy- types, significance, mechanism, endogenous and exogenous factors regulating dormancy, role of phytochrome and PGR, genetic control of dormancy.

Unit III

Seed viability and longevity, pre and post-harvest factors affecting seed viability ; seed ageing ; physiology of seed deterioration ; lipid peroxidation and other viability theories; means

to prolong seed viability; mechanism of desiccation sensitivity and recalcitrance with respect to seed longevity.

Unit IV

Seed vigour and its concept, vigour test methods, factors affecting seed vigour, physiological basis of seed vigour in relation to crop performance and yield. Seed invigoration and its physiological and molecular control.

Practical

Proximate analysis of chemical composition of seed; methods of testing viability; kinetics of seed imbibition and solute leakage; seed germination and dormancy breaking methods; seed invigoration and priming treatments; accelerated ageing and controlled deterioration tests; enzymatic activities and respiration during germination and effect of accelerated ageing; vigour testing methods etc. 62

Suggested Readings

1. Agrawal, P.K. and Dadlani, M. (Eds.)., 1992, Techniques in Seed Science and Technology. South Asian Publ. Baskin, C.C. and Baskin, J.M., 1998, Seeds: Ecology, Biogeography and Evolution of Dormancy andGermination. Academic Press.
2. Basra, A.S., 2006, Handbook of Seed Science and Technology. Food Product Press.
3. Bench, A.L.R. and Sanchez, R.A., 2004, Handbook of Seed Physiology. Food Product Press.
4. Bewley, J.D. and Black, M., 1982, Physiology and Biochemistry of Seeds in Relation to Germination. Vols. I, II. Springer Verlag.
5. Bewley, J.D. and Black, M., 1985, Seed: Physiology of Seed Development and germination. Plenum Press. Copeland, L.O. and Mc Donald, M.B., 1995, Principles of Seed Science and Technology. 3rd Ed. Chapman & Hall.
6. Khan, A.A., 1977, Physiology and Biochemistry of Seed Dormancy and germination. North Holland Co. Kigel, J. and Galili, G. (Eds.)., Seed Development and Germination. Marcel Dekker.
7. Murray, D.R., 1984. Seed Physiology. Vols. I, II. Academic Press.
8. Sadasivam, S. and Manickam, A., 1996, Biochemical Methods. 2nd Ed. New Age.

SST - 510 **SEED PATHOLOGY** **2+1**

Theory

Unit I

History and economic importance of seed pathology in seed industry and plant quarantine; terminology, important seed transmitted pathogens; seed microbes and their mode of action, detection techniques and identification of common seed borne pathogens.

Unit II

Morphology and anatomy of typical monocotyledonous and dicotyledonous seeds; mode and mechanism of transmission of seed borne pathogens and microorganisms. Rate of transmission of major plant pathogens, microorganisms in relation to seed certification and tolerance limit; type of losses caused by seed- borne diseases.

Unit III

Role of microorganisms in seed quality deterioration; management of seed borne plant pathogens/ diseases and procedure for healthy seed production; different seed health testing methods for detecting microorganisms; treatments to control seed borne diseases.

Unit IV

Pest Risk Analysis (PRA) and disease free seed production, Sanitary & Phytosaintory (SPS) requirements in seed trade, International regulation (ISHI) in respect of seed health standards. 63

Practical

Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed borne fungi, bacteria and viruses, identification of storage fungi, control of seed borne diseases, seed treatment methods.

Suggested Readings

Agarwal, V.K. and Sinclair, J.B., 1997, Principles of Seed Pathology. Boca Raton.
Karuna, V., 2007, Seed Health Testing. Kalyani.
Neergaard, P., 1988, Seed Pathology. Mac Millan.

Note : Being offered from the Plant Pathology Department under the head PAT-520

SST - 511 **SEED ENTOMOLOGY** **2+1**

Theory

Unit I

Principles of seed entomology; pollinator insects, insect pests and their classification based on mode of infestation etc.

Unit II

Principles of insect pollination, role of pollinators in seed production. Augmenting quality seed production through honeybee pollination in crucifers and forage legumes. Plant protection measures in bee pollinated crops. Management of pollinators for hybrid seed production.

Unit III

Major insect pests of principal crops and their management practices. Methods of insect pest control. Classes of pesticides, their handling and safe use on seed crops.

Unit IV

Storage insect pests infecting seeds, their development and economic importance. Storage losses due to pests, control of storage pests, Management of storage insects pests, mites and rodents, seed sampling and loss estimation.

Unit V

Principles of fumigation and their use, effect of different fumigants; preservatives and seed protectants on seed quality; Type of storage structures – domestic and commercial.

Practical

Collection and identification of insect-pollinators, collection and identification of

important pests of stored seeds. Detection and estimation of pest infestation vis- a- vis loss of seed quality. Safe handling and use of fumigants and insecticides ; safety measures in fumigating and disinfecting , exposure period, aeration etc. the storage structures. Plant protection equipments, their operation and maintenance. Pesticides, its dose determination, preparation of solution and its application.

Suggested Readings

1. Agarwal, N.A. and Girish, G.K., 1977, An Introduction to Action Programme to Regress on Farm Storage Losses in India. FAO/NORAD Seminar on Farm Storage Grain in India, Nov. 29-Dec. 8, 1977.
2. Anderson, J.A. and Aleock, A.W., 1954, Storage of Cereal Grain & their Products. American Assoc. Cereal Chemists, St. Pauls, Minn. 64
3. Cotiong, R.T., 1963, Insect Pests of Stored Grain and Grain Products. Burgess Publ. Co., Minneopolis, Minn., USA.
4. Monro., 1969, Manual of Fumigation for Insect Control. FAO Rome Agril. Studies No. 79.
5. Subramanyam, B. and Hagstrum, D.W., 1995, Interrelated Management of Insects in Stored Products. Marcel Dekker.

6. Note : Being offered from the Agril Entomology Department under the head ENT-513

SST – 512 SEED PRODUCTION IN FORAGE, PASTURE AND GREEN MANURE CROPS 2+1

Theory

Unit I

Important pasture and forage legume crops in India; seed requirement and production; classification of forage, pastures and green manure crops; pollination behavior. Factorts influencing seed production ; maintenance of varietal purity, generation system of

Unit II

seed multiplication self pollinated crops; seed production in apomictic grasses..

Unit III

Methods and techniques of seed production in important grasses, pastures, legumes and green manure crops; apomictic seed.

Unit IV

Selection of seed production areas, influence of season, seed rate and spacing, sowing methods, direct seed sowing, transplanting, pelleting, fertilizer and manure requirement, isolation distance, weed control, pollination and seed setting, seed shattering, seed maturity and stage of harvest, seed collection, economics of seed production of important fodder crops.

Unit V

Seed processing, seed treatment, seed storage, seed viability of these crops.

Practical

Study of flower structure, seed collection and identification, characteristics of forage,

pastures and green manure crops; maturity indices for harvest, seed testing- sampling, purity, moisture, germination and dormancy, seed treatments.

Suggested Readings

1. Farity, D.T. and Hampton, J.C., 1997, Forage Seed Production. Vol. I. Temperate species. CABI. Froma, J., 1997, Temperate Forage Legumes. CABI.
2. Gutterridge, R.G., 1997, Forage Tree Legumes in Tropical Agriculture.
3. CABI. Quality Declared Seed System. 2007. FAO Plant Production and Protection Publication No.185: FAO, Rome. 65

SST - 513 SEED STORAGE AND DETERIORATION 1+1

Theory

Unit I

Life span of seeds of plant species; classification of seeds on the basis of storage behaviour; orthodox and recalcitrant seeds; types of storage; kinds of seed storage (open, bulk, controlled, hermetic, germplasm, cryopreservation); soil seed bank; terminology; survival curve of seed.

Unit II

Factors affecting seed storability- biotic and abiotic and pre- and post-harvest factors affecting seed longevity; the effects of packaging materials, storage fungi and insects, seed treatment and fumigation and storage environmental conditions on seed storability; moisture equilibrium in seeds; hysteresis effect; thumb rules; selection of suitable areas/places for safe storage; prediction of relative storability and longevity of seed lots, viability equations and nomographs.

Unit III

Concept of seed ageing and deterioration, its causes, symptoms, mechanisms and related theories; different changes associated with the loss of vigour and viability during storage; application of physiological and biochemical techniques for evaluation of seed ageing; genetics of seed viability; effect of seed ageing on crop performance; maintenance of viability and vigour during storage; seed amelioration techniques, mid storage corrections etc.

Unit IV

Storage methods- requirement of storage facilities in India; types and storage structures available in the country and their impact on short and long term storage; methods of safe seed storage including eco-friendly techniques used in various group of crops viz. cereals, pulses, oilseeds, fibers, forages and vegetables; operation and management of seed stores; fruit storage; viability loss during transportation and interim storage.

Practical

Study on the effect of storage environmental factors (RH, SMC and temperature) on seed longevity. Study on the effect of packaging materials, seed treatment and fumigation on storability; prediction of storability and longevity of seed-lots by using viability equations and

nomographs; standardization of accelerated ageing (AA) technique for assessing the seed storability of various crops; estimation of carbohydrates, proteins, fats, enzyme activities, respiration rate and nucleic acids in fresh and aged seeds; use of eco-friendly products and amelioration techniques to enhance quality of stored seeds, visit to seed stores.

Suggested Readings

1. Barton, L.V., 1961, Seed Preservation and Longevity. Burgess Publ.
2. Basra AS. (Ed.)., 1995, Seed Quality: Basic Mechanisms and Agricultural Implications. Food Products Press. Basra, A.S., 2006, Handbook of Seed Science and Technology. Food Product Press. 66
3. Desai, B.B., 2007, Seed Handbook: Biology, Production, Processing and Storage. Marçel Dekker. Doijode, S.D., 2001, Seed Storage of Horticultural Crops.
4. CBS. Justice, O.L. and Bass, L.N., 1978, Principles and Practices of Seed Storage. Castle House Publ.
5. Kharb, R.P.S. and Kharb, P., 1977, Biochemical and Cytogenetical Changes During Storage. In: Seed Technology (Eds. BS Dahiya & KN Rai): pp. 160-168.
6. McDonald, M.B. and Roos, E.E. (Eds.)., 1986, Physiology of Seed Deterioration. Paper No. 11, Crop Science Society of America, USA.
7. Roberts, E.H., 1972, Viability of Seeds. Chapman & Hall.

SST - 514 SEED MARKETING AND MANAGEMENT 1+1

Theory

Unit I

Importance and promotion of quality seed, formal and informal seed supply systems. Basic concepts of marketing with special reference to seed; importance and scope of seed industry in India, major constraints/problems in seed industry/seed sector role of seed association / federation in seed trade.

Unit II

Demand and supply of seed; Role of seed replacement rate (SRR), seed multiplication ratio (SMR), cost of production and returns; determining seed needs; seed pricing and price policy, seed processing and /packaging, demand forecasting.

Unit III

Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins.

Unit IV

Salient features of national seed policies, role of various sectors/agencies in efficient seed marketing, quality control and assurance programme. Responsibilities of seed companies and dealers under Seed Act, EXIM policies for seed trade etc.

Practical

Statutory requirements in seed business including R&D, estimation of cost of seed production, marketing costs and margins of seeds of different crops, case studies to compare public & private sectors in different conditions, impact analysis., seed pricing, cost benefit

ratio, economic feasibility of seed industry etc.

Suggested Readings

1. Kohls, R.L. and Uhl, J.N., 1980, Marketing of Agricultural Products.
2. MacMillan. Kundu, K.K. and Suhag, K.S., 2006, Teaching Manual on Seed Marketing andManagement. Department of Agricultural Economics CCS HAU, Hisar. 67
3. Venugopal, P., 2004, State of Indian Farmers: A Millennium Study. Vol. VIII. Input Management. Academic Foundation, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.

SST 515 EMERGING TRENDS IN SEED QUALITY ENHANCEMENT 1+1

Theory

Unit I

Concept and significance of seed quality enhancement; physical, chemical and pesticidal seed treatments, history, principles and methods of seed treatment, methodology and factors affecting seed enhancement treatments.

Unit II

Seed priming: physiological and biochemical basis, types of priming technology, biochemical and molecular changes associated, pregermiantion, film coating and pelleting, seed tapes, seed mats, seed colouring, biopriming.

Unit III

Synthetic seeds – Aim and scope for synthetic seeds, historical development, somatic embryogenesis, somaclonal variation and their control, embryo encapsulation systems, hardening of artificial seeds, cryopreservation, storage of artificial seeds, desiccation tolerance, use of botanicals in improving seed quality etc.

Practical

Seed treatments – methods and techniques, equipments required for seed treatment, film coating; seed invigoration/priming - hydration and dehydration, PEG priming, solid matrix priming, bio priming, effects of priming; methods for hydrogel encapsulation of artificial endosperm, hydrophobic coating etc.; protocols for production of synthetic seeds, Visit to leading Seed Companies to study the seed treatment processes.

Suggested Readings

1. Basra, A.S. (Ed.)., 1995, Seed Quality: Basic Mechanisms and Agricultural Implications. Food Product Press, NY.
2. Basra, A.S., 2006, Handbook of Seed Science and Technology. Food Product. Press, NY
3. Bench, A.L.R. and Sanchez, R.A., 2004, Handbook of Seed Physiology. Food Product Press, NY/ London. Copland, L.O. and McDonald, M.B., 2004, Seed Science and Technology. Kluwer Acad.
4. Kalloo, G., Jain, S.K., Vari, A.K. and Srivastava, U., 2006, Seed: A Global Perspective. Associated Publishing Company, New Delhi.

SST–516 GERMPLASM COLLECTION, EXCHANGE AND QUARANTINE 2+1

Theory

Unit I

History and importance of germplasm exploration; Distribution and extent of prevalent genetic diversity; Phyto-geographical regions/ecological zones and associated diversity; Mapping eco-geographic distribution of diversity, threatened habitats, use of flora.

Unit II

Concept of population and gene pool; Variations in population and their classification; Gene frequencies in populations, rare and common alleles; Gene pool sampling in self and cross pollinated and vegetatively propagated species; Non-selective, random and selective sampling strategies; Strategies and logistics of plant exploration and collection; Coarse and fine grid surveys; Practical problems in plant exploration; Use of in vitro methods in germplasm collection.

Unit III

Ethno botanical aspects of PGR; Crop botany, farming systems, collecting wild relatives of crop plants; Collection and preservation of specimens; Importance and use of herbaria and preparation of herbarium specimens.

Unit IV

Post-exploration handling of germplasm collections; Present status and future strategies in collection of major crops of Indian origin such as rice, maize, sorghum, sesame, Brassica, okra, eggplant, cotton, mango etc; approaches for collection including indigenous knowledge.

Unit V

History, principles, objectives and importance of plant introduction; Prerequisites, conventions, national and international legislations and policies on germplasm collection and exchange; Documentation and information management; Plant quarantine- introduction, history, principles, objectives and relevance; Regulations and plant quarantine set up in India; Pest risk analysis, pest and pathogen information database; Quarantine in relation to integrated pest management; Economic significance of seed-borne pests (insects, mites, non-insect pests, nematodes, fungi, bacteria, viruses, phytoplasma etc.).

Unit VI

Detection and identification of pests including use of recent techniques like ELISA, PCR etc., Symptoms of pest damage, salvaging techniques for infested/infected germplasm, post-entry quarantine operation, seed treatment and other prophylactic treatments and facilities; Domestic quarantine; seed certification; International linkages in plant quarantine; weaknesses and future thrust.

Unit VII

Genetically modified organisms (GMOs) or genetically engineered plants (GEPs). Concepts of biosafety, risk analysis and consequences of spread of GE crops on the environment; Treaties and multilateral agreements governing trans-boundary movement of GEPs or GMOs, Indian regulatory system for biosafety.

Practical

Plant exploration and collection; Techniques of coarse and fine grid surveys; Identification of wild relatives of crop plants- Example of collection, cataloguing and preservation of specimens; Sampling techniques 69 of plant materials; Visiting ports, airports to study the quarantine regulations; Techniques for the detection of insects, mites, nematodes, bacteria, weeds, pathogens and viruses on seed and planting materials and salvaging; Use of visual, qualitative, quantitative, microscopic, molecular and plant growth related techniques(controlled green houses/growth chambers, etc); Detection of GMOs and GEPs; Study of post-entry quarantine operation, seed treatment and other prophylactic treatments.

Suggested Readings

Briggs, D., 1997, Plant Variation and Evolution. Science Publ.

Cronquist, A.J., 1981, An Integrated System of Classification of Flowering Plants. Columbia.Univ. Press. Dhillon, B.S., Varaprasad, K.S., Kalyani, S., Singh, M., Archak, S., Srivastava, U. and Sharma, G.D., 2001,

Germplasm Conservation A Compendium of Achievements. NBPGR, New Delhi.

di Castri, F. and Younes, T., 1996, Biodiversity Science and Development: Towards New Partnership. CABI & International Union for Biol. Sci. France.

Gurcharan Singh., 2004, Plant Systematics: An Integrated Approach. Science Publ. Lawrence, G.M.H. (Ed.)., 1951, Taxonomy of Vascular Plants. London.

Paroda, R.S. and Arora, R.K., 1991, Plant Genetic Resources Conservation and Management Concepts and Approaches. IPGRI Regional office for South and South Asia, New Delhi.

Pearson, L.C., 1995, The Diversity and Evolution of Plants. CRC Press.

Singh BP. 1993. Principles and Procedures of Exchange of Plant Genetic Resources Conservation and Management. Indo-US PGR Project Management.

Sivarajan, V.V., 1991, Introduction of Principles of Plant Taxonomy. Science Publ. Stace CA, Plant Taxonomy and Biosystematics 2nd Ed. Cambridge Univ. Press.

Takhrajan, A., 1997, Diversity and Classification of Flowering Plants. Columbia Univ. Press. Wiersema, J.H., 1999, World Economic Plants: A Standard Reference. Blanca Leon.

Suggested Broad Areas for Master's /Doctoral Research

- Isolation distance requirements in view of GM varieties
- Review of seed certification standards
- GOT –seasonal requirements
- Genetic purity vis-a-vis trait purity
- Enhancement of pollen viability, stigma receptivity and seed setting
- Reduction of processing losses
- Alternate areas / protected cultivation methods for hybrid seed production
- Standardising processing needs in high value crops and forage grasses
- Protein and oil content in GM cotton seed and its effect on longevity
- Optimisation of hybrid seed production technology in field crops, vegetables and flowers
- Pollen collection methods and viability testing
- Management of seed borne diseases
- Seed enhancement for unfavorable conditions

Annexure-V

AGENDA: Institutionalization of B. Sc. (Hons.) Horticulture at SKUAST-Jammu

1. **Degree Nomenclature**: B.Sc. (Hons.) Horticulture
2. **Eligibility Criteria**: 10+2/intermediate with PCB, PCMB, PCM, PC Forestry or Inter (Agriculture) (P- Physics, C-Chemistry, M-Mathematics, B-Biology), from recognized Board/university.
3. **Medium of Instruction**: English
4. **Minimum Intake**: 30 students per year
5. **Examination**
   a. External theory (50%)
   b. Internal Theory + Practical (50%)
   - Courses with Theory and Practical:
     Mid-term Exam (30%) + Assignment (5%) in practical oriented courses + Practical (15%)
   - Courses with only Theory:
     Mid-term Exam (40%) + Assignment (10%)
   - Courses with only Practical: (100%) Internal

6. **Curriculum for under graduate programme in Horticulture**

i) UG degree: B.Sc. (Hons.) Horticulture

Department Wise Courses

I FRUIT SCIENCE

S. No.	Course No.	Title of the Course	Cr. Hrs	Semester
1.	FSC-111	Fundamentals of Horticulture	3(2+1)	I
2.	FSC-112	Plant Propagation and Nursery Management	2(1+1)	I
3.	FSC-113	Fundamentals of Genetics and Cytogenetics	3(2+1)	I
4.	FSC-121	Temperate Fruit Crops	3(2+1)	II
5.	FSC-122	Tropical and Subtropical Fruits	3(2+1)	II
6.	FSC-123	Fundamentals of Plant Breeding	3(2+1)	II
7.	FSC-124	Dryland Horticulture	2(1+1)	II
8.	FSC-211	Growth and Development of Horticultural Crops	2(1+1)	III
9.	FSC-221	Breeding of Fruit and Plantation Crops	3(2+1)	IV
10.	FSC-222	Orchard and Estate Management	2(1+1)	IV
11.	FSC-223	Plantation Crops	2(1+1)	IV
		Total	**28 (17+11)**	

II VEGETABLE SCIENCE

1	VSC-121	Tropical and Subtropical Vegetable Crops	3(2+1)	II
2	VSC-211	Temperate Vegetable Crops	2(1+1)	III
3	VSC-212	Spices and Condiments	3(2+1)	III

4	VSC-222	Potato and Tuber Crops	2(1+1)	IV
5	VSC-311	Breeding of Vegetable, Tuber and Spice Crops	3(2+1)	V
6	VSC-312	Precision Farming and Protected Cultivation	3(2+1)	V
7	VSC-321	Seed Production of Vegetable, Tuber and Spice Crops	3(2+1)	VI
		Total	**19 (12+7)**	

III. POSTHARVEST TECHNOLOGY

1	PHT-121	Fundamentals of Food Technology	2(1+1)	II
2	PHT-311	Postharvest Management of Horticultural Crops	3(2+1)	V
3	PHT-321	Processing of Horticultural Crops	3(1+2)	VI
		Total	**8 (4+4)**	

IV. FLORICULTURE AND LANDSCAPE ARCHITECTURE

1	FLA-111	Commercial Floriculture	3(2+1)	I
2	FLA-211	Ornamental Horticulture	2(1+1)	III
3	FLA-221	Principles of Landscape Architecture	1 (0+1)	IV
4	FLA-321	Breeding and Seed Production of Flower and Ornamental Crops	3(2+1)	VI
		Total	**9 (5+4)**	

V. PLANT PATHOLOGY

1	PPP-211	Fundamentals of Plant Pathology	3(2+1)	III
2	PPP-221	Diseases of Fruit, Plantation and Medicinal and Aromatic Crops	3(2+1)	IV
3	PPP-311	Diseases of Vegetable, Ornamental and Spice Crops	3(2+1)	V
		Total	**9 (6+3**	

ENTOMOLOGY

1	PPE-211	Fundamentals of Entomology	3(2+1)	III
2	PPE-212	Nematode Pests of Horticultural Crops and Their Management	2(1+1)	III
3	PPE-221	Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops	3(2+1)	IV
4	PPE-321	Apiculture, Sericulture and Lac Culture	2(1+1)	VI
5	PPE-322	Insect Pests of Vegetable, Ornamental and Spice Crops	3(2+1)	VI
		Total	**13 (8+5)**	

VII. NATURAL RESOURCE MANAGEMENT

1	NRS-111	Fundamentals of Soil Science	2(1+1)	I
2	NRS-121	Soil Fertility and Nutrient Management	2(1+1)	II

3	ENS-121	Environmental Studies and Disaster Management	3(2+1)	II
4	NRS-122	Water Management in Horticultural Crops	2(1+1)	II
5	NRS-211	Farm Power and Machinery	2(1+1)	III
6	NRS-221	Soil, Water and Plant Analysis	2(1+1)	IV
7	ENS-221	Agro-meteorology and Climate Science	2(1+1)	IV
8	NRS-311	Organic Farming	2(1+1)	V
9	AGF-311	Introductory Agro-Forestry	2(1+1)	V
		Total	**19 (10+9)**	

VIII. BASIC SCIENCE

1	BSB-111	Introductory Crop Physiology	2(1+1)	I
2	BSM-111	Introductory Microbiology	2(1+1)	I
3	BSC-211	Elementary Plant Biochemistry	2(1+1)	III
4	BSS-311	Elementary Statistics and Computer Application	3(2+1)	V
5	ENG-001	Communication Skills and Personality Development	2(1+1)	I
6	BSB-001	Introductory Botany (deficiency Course for students from PCM stream)	3(2+1) (NC)	I
7	BSM-001	Basic Mathematics (deficiency Course for students from PCB stream)	3(3+0) (NC)	I
		Total	**17 (11+6)**	

IX. OTHERS (Biotechnology, Seed Science & Technology, Business Management, Forest Products, Social Science, CIC, Physical Education and NCC/NSS)

1.	AGRON-211	Introduction to Major Field Crops	2(1+1)	III
2.	NRE-221	Introductory Economics and Marketing	3(2+1)	IV
3.	BTC-311	Elementary Plant Biotechnology	2(1+1)	V
4.	EXT-311	Fundamentals of Extension Education	2(1+1)	V
5.	BMH-321	Horti-Business Management	2(2+0)	VI
6.	ICT-321	Information and Communication Technology	2(1+1)	VI
7.	AGRON-212	Weed Management in Horticultural Crops	2 (1+1)	III
8.	FPR-321	Medicinal and Aromatic Crops	3 (2+1)	VI
9.	BMH-322	Entrepreneurship Development & Business Management	2(1+1)	VI
10.	PED-001	Physical and Health Education	1(0+1) NC	I
11.	ORI-001	Orientation	1 (1+0) NC	I
12.	-	NCC/NSS (Semesters I-IV)	4 (0+4) NC	I-IV
		Total	**24 (12+12)**	

STUDENT READY

Sr. No.	Activity	Cr. Hrs.	Semester
1	Experiential Learning Programme (Professional Package)	20(0+20)	VII
2	RHWE & Attachment with Industries/Research Stations	20(0+20)	VIII
	Total	**40 (0+40)**	

I. Professional Packages Hands on Training /Experimental Learning Modules (0+20):

ELH-411	Commercial Horticulture (Fruits)	(0+10)
ELH-412	Protected Cultivation of High Value Horticulture Crops (Vegetables)	(0+10)
ELH-413	Processing of Fruits and Vegetables for Value Addition	(0+10)
ELH-414	Floriculture and Landscape Architecture	(0+10)
ELH-415	Mushroom Cultivation	(0+10)
ELH-416	Bee Keeping	(0+10)

Batch of students can select two modules under STUDENT READY - Experiential Learning Programme depending on the facilities available at the College.

II. Rural Horticultural Work Experience Programme **20 (0+20)**

RHW-421	Rural Horticultural Works Experience	0+10
RHW-422	Attachment with Research Stations / KVK's	0+10

i. **STUDENT READY - Placement in Villages (0+10)**

ii. **STUDENT READY- Placement in Industries (0+10)**

S. No.	RHWE Programme Schedule	Duration
1	**Orientation Programme**	**2 weeks**
2	**Village stay at Research Stations / KVKs**	**12 weeks**
3	**All India Study Tour**	**3 weeks**
4	**Placement Programme**	**4 weeks**
5	**Report Writing & Final Examination**	**3 weeks**
	Total	**24 weeks**

S. No.	Activity	Credits
1.	Experiential learning (Professional Package)	0+20
2.	RHWE& Placement in Industries	0+20
	Total	**0+40**

S. No.	RHWE Programme schedule	Duration
1	Orientation Programme	2 weeks
2	Village stay	12 weeks
3	All India Study Tour	3 weeks
4	Placement Programme	4 weeks
5	Report writing & Final Examination	3 weeks
	Total	**24 Weeks**

STUDENT READY:

Professional Packages Hands on Training /Experimental Learning Modules: Final year B.Sc. (Hort.) students can select two modules under STUDENT READY- Experiential Learning programme depending on the facilities available at the college.

1. Commercial Horticulture
2. Protected cultivation of high value Horticulture crops
3. Processing of fruits and vegetables for value addition
4. Floriculture and landscape architecture
5. Bio-inputs: Bio-fertilizers and bio-pesticides
6. Mass multiplication of plant and molecules through tissue culture
7. Mushroom culture
8. Bee keeping

Batch of student can select two modules under STUDENT READY- Experiential Learning Programme depending on the facilities available at the college.

II. Rural Horticultural Work Experience Programme (0+20)

i) STUDENT READY - Placement in Industries (0+10)

ii) STUDENT READY- Placement in Villages (0+10)

COURSE CONTENTS

SEMESTER-I

NRS-111 FUNDAMENTALS OF SOIL SCIENCE 1+1

Theory

Composition of earth's crust, soil as a natural body – major components. Eluviations and alleviations formation of various soils. Physical parameters; texture – definition, methods of textural analysis, stock's law, assumption, limitations, textural classes, use of textural triangle; absolute specific gravity/particle density, definition, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between BD (bulk density), AD – practical problems. Pore space – definition, factors affecting capillary and non-capillary porosity, soil colour – definition, its significance, colour variable, value hue and chroma. Munsellcolour chart, factors influencing, parent material, soil moisture, organic matter, soil structure, definition, classification, clay prism like structure, factors influencing genesis of soil structure, soil consistency, plasticity, Atterberg's constants. Soil air, air capacity, composition, factors influencing, amount of air space, soil air renewal, soil temperature, sources and distribution of heat, factors influencing, measurement, chemical properties, soil colloids, organic, humus, inorganic, secondary silicate, clay, hydrous oxides. Ion exchange, cation-anion importance, soil water, forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts, PF scale, measurement, gravimetric – electric and tensiometer methods – pressure plate and pressure membrane apparatus – Neutron probe – soil water movement – classification – aerial photography – satellite of soil features – their interpretation; soil orders; land capability classification; soil of different eco-systems and their properties, Rock & Minerals classification, Pedogenic process. Objectives of soil science research institute in India (NBSS&LUP, ISSS, LTFE & NSSTL). Management of Soil Crusting, Soil Compaction and Soil Compression. Soil Biology benefits and harmful effects. Methods and objective of soil survey, Remote sensing application in soil and plant Studies, Soil degradation.

Practical

Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density. Textural analysis of soil by Robinson's pipette method. Description of soil profile in the field. Quantification of minerals and their abundance. Determination of Soil colour using Munsell Chart. Estimation of water holding capacity and hydraulic conductivity of soils. Estimation of Infiltration rate using double ring infiltrometer method. Estimation of soil moisture using gypsum block and neutron probe method. Soil compaction measurement with Pentrometer. Determination of pore space of soil. Determination of filed capacity and permanent wilting point of soil. Determination of soil water potential characteristic curves by tensiometer and pressure plate apparatus. Aggregate size distribution analysis of soil. Air capacity of soil by field method.

Suggested reading

Biswas T D and Mukharjee S K. 2015. *Text Book of Soil Science*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Brady N C and Weil R R. 2014. *Nature and Properties of Soils*. Pearson Education Inc., New Delhi.

Das D K. 2015. *Introductory Soil Science*. Kalyani Publishers, Ludhiana.

Foth H D. 1991. *Fundamentals of Soil Science* (8th Edition), John Wiley & Sons, New Delhi.

Gupta P K. 2009. *Soil, Plant, Water and Fertilizer Analysis* (2nd Edition), AGROBIOS, Jodhpur (India).

Indian Society of Soil Science, 2002. *Fundamentals of Soil Science*. IARI, New Delhi.

Jackson M L. 2012. *Soil Chemical Analysis*: Advanced Course, Scientific Publisher

Sehgal J A. 2005. *Textbook of Pedology : Concepts and Applications*. Kalyani Publishers, New Delhi.

Sharma P K. 2017. *Introduction to Soil Physics*. Westville Publishing House, New Delhi.

BSB-111 INTRODUCTORY CROP PHYSIOLOGY 1+1

Theory

Water Relations in Plants: Role of water in plant metabolism, osmosis inhibition, diffusion, water potential and its components, measurement of water potential in plants, absorption of water, mechanism of absorption and ascent of sap. Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata. Osmotic pressure, guttation, stem bleeding: transpiration methods and mechanism and factors affecting transpiration. Drought: Introduction to different types of stresses; water, heat and cold tolerance. Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism. Biological Nitrogen Fixation, Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and non-cyclic electron transfer, CO_2 fixation – C3, C4 and CA metabolism, advantages of C4 pathway. Photorespiration and its implications, factors affecting photosynthesis.

Practical

Measurement of water potential, osmosis, root pressure, structure of the stomata, distribution, opening and closing of the stomata, measurement, transpiration and calculation of transpirational pull demonstration. Importance of light and chlorophyll in photosynthesis, pigment identification in horticultural crops, measurement of relative water content (RWC), studying plant movements.

Suggested reading

Basra A S. 2004. *Plant Growth Regulators in Agriculture & Horticulture*. Haworth Press. New York.

Delvin R M . 1986. *Plant Physiology*. CBS. Delhi.

Edward E D. 2014. *Principles of Horticultural Physiology*. CABI, UK.
Horst Marschner. 1995. *Mineral Nutrition of Higher Plants*. Academic Press. USA.
Salisbulry F B and Ross C. 2007. *Plant Physiology*. CBS. New Delhi.
Taiz L and Zeiger E. 2010. *Plant Physiology* (5th Edition). SINAUR. USA.

FLA-111 COMMERCIAL FLORICULTURE 2+1

Theory

Scope and importance of commercial floriculture in India, production techniques of commercial flower crops like rose, marigold, chrysanthemum, orchid, carnation, gladiolus, jasmine, crossandra, anthurium, dahlia, tuberose, bird of paradise, china aster and gerbera for domestic and export market, production techniques of flowers and foliage filler materials growing of flowers under protected environments such as glass house, plastic house etc., postharvest technology of cut flowers in respect of commercial flower crops, Importance of flower arrangement, Ikebana, techniques, types, suitable flowers and cut foliage, dehydration technique for drying of flowers. Commercial flower production techniques for bulbous ornamentals. Propagation of ornamentals.

Practical

Identification of commercially important floricultural crops. Propagation practices in chrysanthemum, sowing of seeds and raising of seedlings of annuals. Propagation by, cutting, layering, budding, grafting, different methods of propagation in bulbous plants etc. Training and pruning of roses. Use of chemicals and other compounds for prolonging the vase life of cut flowers. study and practice of different types of flower arrangements, preparation of floral bouquets, preparation of floral rangoli, veni etc., Drying and preservation of flowers.

Suggested reading

Bhattacharjee S K and De L C. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers, Distributors, Jaipur (Rajasthan) India.
Bose T K, Yadav L P, Patil P, Das P and Parthasarthy V A. 2003. *Commercial Flowers*. Partha Sankar Basu, Naya Udyog, 206, Bidhan Sarani, Kolkata
Choudhary D and Mehta A. 2010. *Flower Crops : Cultivation and Management*. Oxford Book Company, Jaipur, India.
Randhawa G S and Mukhopadhyay A. 2004. *Floriculture in India*. Allied Publishers Pvt. Ltd.
Sheela V L. 2008. *Flower for Trade*. New India Publishing Agency, Pitampura, New Delhi
Singh A K. 2006. *Flower Crops : Cultivation and Management*. New India Publishing Agency, Pitampura, New Delhi.

BSM-111 INTRODUCTORY MICROBIOLOGY 1+1

Theory

History and Scope of Microbiology: The discovery of micro-organism, spontaneous generation conflict, germ theory of diseases, microbial effect on organic and inorganic matter. Development of microbiology in India and composition of microbial world. Microscopy and

Specimen Preparation: The bright field microscope, fixation, dyes and simple staining, differential staining. Difference between prokaryotic and eukaryotic cells. Prokaryotic cell structure and functions. Types of culture media and pre-culture techniques. Microbial growth in models of bacterial, yeast and mycelia growth curve. Measurement of bacterial growth. General properties of viruses and brief description of bacteriophages. DNA as genetic material.

Practical

Examination of natural infusion and living bacteria; examination of stained cells by simple staining and Gram staining. Methods for sterilization and nutrient agar preparation. Broth culture, agar slopes, streak plates and pour plats, turbid metric estimation of microbial growth.

Suggested reading

Edward Alchano. 2002. *Introduction to Microbiology.* Jones and Bartlett hearing.

Heritage J, Evans, E G V and Killington, R A. 2008. *Introductory Microbiology*. Cambridge University Press, UK.

Jamaluddin M, Malvidya N and Sharma A. 2006. *General Microbiology*. Scientific Publishers, Washington.

Madigan M T and Martinko J M. 2014. *Brock Biology of Microorganisms* 14th Edn. Pearson.

Madigan M, Martinkoj M and Parker. 2003. *Biology of Microorganisms* (10th Ed.). Prentice Hall of India Pvt. Ltd., New Delhi.

Pelczar Jr. Chan M.J.E.C.S and Krieg N R. 1996. *Microbiology*. McGraw Hill Publishers, New York.

Pelczer M J. 1998. *Microbiology* 5th Edn. Tata McGraw Hill Education Pvt. Ltd.

Prescott L M, Harley J P and Klein D A. 2002. *Microbiology* (5th Ed). McGraw Hill Publishers, New York.

Singh R P. 2007. *General Microbiology*. Kalyani Publishers.

Stainer R. 1987. *General Microbiology*. Palgrave Macmillan.

Sullia S B and Shanta R. 1998. *General Microbiology*. Oxford and IBH, New Delhi.

FSC-111 FUNDAMENTALS OF HORTICULTURE 2+1

Theory

Scope and importance, classification of horticultural crops and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery techniques and their management, climate, principles, planning and layout, management of orchards, planting systems and planting densities. Production and practices for fruit crops. Principles objectives, types and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management– irrigation methods, merits and demerits, weed management, fertility management in horticultural crops-manures and fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping, mulching– objectives, types merits and demerits, Classification of bearing habits of fruit trees, factors

influencing the fruitfulness and unfruitfulness. Top working, frame working, principles of organic farming, market chain management.

Practical

Features of orchard, planning and layout of orchard, tools and implements, identification of various horticultural crops, digging of pits for fruit plants, planting systems, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, preparation and application of growth regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits, assessment of bearing habits, maturity standards, harvesting, grading, packaging and storage.

Suggested reading

Chadha K L. 2001. *Handbook of Horticulture*. ICAR, New Delhi

Denisen E L. 1957. *Principles of Horticulture*. Macmillan Publishing Co., New York.

Edmond J B, Sen T L, Andrews F S and Halfacre R G. 1963. *Fundamentals of Horticulture*. Tata McGraw Hill Publishing Co., New Delhi.

Kumar N. 1990. *Introduction to Horticulture*. Rajyalakshmi Publications, Nagarcoil, TamilNadu

Peter K V. 2009. *Basic Horticulture*. New India Publishing Agency

Prasad S and Kumar U. 2010. *A Handbook of Fruit Production*. Agrobios (India).

Salunkhe D K and Kadam S S. 2013. *A Handbook of Fruit Science and Technology*. CRC Press.

Singh J. 2002. *Basic Horticulture*. Kalyani Publishers, Hyderabad.

Singh N P. 2005. *Basic concepts of Fruit Science* 1st Edn. IBDC Publishers.

FSC-112 PLANT PROPAGATION AND NURSERY MANAGEMENT 1+1

Theory

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Seed dormancy types of dormancy (scarification & stratification) internal and external factors, nursery techniques nursery management, apomixis – mono-embryony, polyembryony, chimeras & bud sports. Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, phytotrons nursery (tools and implements), use of growth regulators in seed, types and stages of seed germination with examples and vegetative propagation, methods and techniques of division-stolons, pseudobulbs, offsets, runners, cuttings, layering, grafting, formation of graft union, factor affecting, healing of graftage and budding, physiological & bio-chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Anatomical studies of bud union, selection and maintenance of mother trees, collection of scion wood stick, scion-stock relationship, and their influences, bud wood certification, techniques of propagation through specialized organs, corm, runners, suckers. Nursery registration act. Insect/pest/disease control in nursery, Cost of establishment of propagation structures.

Practical

Media for propagation of plants in nursery beds, potting and repotting. Preparation of nursery beds and sowing of seeds. Raising of rootstock. Seed treatments for breaking dormancy and inducing vigorous seedling growth. Preparation of plant material for potting. Hardening plants in the nursery. Practicing different types of cuttings, layering, graftings and buddings including opacity and grafting, top grafting and bridge grafting etc. Use of mist chamber in propagation and hardening of plants. Preparation of plant growth regulators for seed germination and vegetative propagation. Visit to a tissue culture laboratory. Digging, labelling and packing of nursery fruit plants. Maintenance of nursery records. Use of different types of nursery tools and implements for general nursery and virus tested plant material in the nursery. Cost of establishment of a mist chamber, greenhouse, glasshouse, polyhouse and their maintenance. Nutrient and plant protection applications during nursery.

Suggested reading

Bose T K, Mitra, S K, Sadhu, M K, Das, P and Sanyal D. *Propagation of Tropical & Subtropical Horticultural Crops, Volume 1(3rd Revised edition)*. Naya Udyog, 206, Bidhan Sarani, Kolkata 700006.

Chadha K L. 2001. *Hand Book of Horticulture*. ICAR, New Delhi.

Ganner R J and Choudhri S A. 1972. *Propagation of Tropical Fruit Trees*. Oxford and IBH Publishing Co., New Delhi.

Hartmann H T, Kester, Dale E, Davies Jr. Fred T and Geneve, Robert L. *Plant Propagation-Principles and Practices* (7th Edition). PHI Learning Private Limited, New Delhi-110001

Rajan S and Markose B L. (series editor Prof. K.V. Peter). *Propagation of Horticultural Crops- Horticulture Science Series Vol.6.* New India Publishing Agency, Pitam Pura, New Delhi-110088.

Sadhu M K.1996. *Plant Propagation*. New Age International Publishers, New Delhi.

Sharma R R. 2002. *Propagation of Horticultural Crops (Principles and Practices)*. Kalyani Publishers, New Delhi.

Sharma R R. 2004. *Plant Propagation and Nursery Management* (1st Ed.). International Book Distributing Co., Lucknow 226 004 U.P. (India)

FSC-113 FUNDAMENTALS OF GENETICS AND CYTOGENETICS 2+1

Theory

Historical background of genetics, theories and hypothesis. Physical basis of heredity, cell reproduction, mitosis, meiosis and its significance. Gametogenesis and syngamy in plants. Mendelian genetics–Mendel's principles of heredity, deviation from Mendelian inheritance, pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Chromosome theory of inheritance, gene interaction. Modification of monohybrid and dihybrid rations. Multiple alleles, quantitative inheritance linkage and crossing over, sex linked inheritance and characters. Cytoplasmic inheritance and maternal effects. Chemical basis of heredity, structure

of DNA and its replication. Evidence to prove DNA and RNA – as genetic material. Mutations and their classification. Chromosomal aberrations, changes in chromosome structure and number.

Practical

Study of fixatives and stains. Squash and smear techniques. Demonstrations of permanent slides and cell division, illustration in plant cells, pollen fertility and viability, determination of gametes, Solving problems of monohybrid, dihybrid, and test cross ratios using chi-square test, gene interactions, estimation of linkages using three point test cross from F_2 data and construction of linkage maps. Genetics variation in pea.

Suggested reading

Gardner E J, Simmons M J and Snustard D P. *Principles of Genetics.* John Wiley & Sons.

Klug W S and Cummings M R. 2003. *Concept of Genetics.* Peterson Edu.

Lewin B. 2008. *Gene IX.* Jones and Bartlett Publication.

Russell P J. 1998. Genetics. The Benzamin/ Cummings Publication Co.

Snustad D P and Simmons M J. 2006. Genetics 4th Ed. John Wiley & Sons.

Strickberger M W.2005. *Genetics(III Ed.).* Prentice Hall, New Delhi, India.

Tamarin R H. 1999. Principles of Genetics. Wm. C. Brown Publication.

Uppal S, Yadav R, Subhadra and Saharan R P. 2005. *Practical Manual on Basic and Applied Genetics.* Department of Genetics, CCS HAU Hisar.

ENG-001 Communication Skills and Personality Development **1+1**

Theory

Structural Grammar: Introduction of Word Classes: Structure of Verb in English: Uses of Tenses; Study of Voice; Study of Conjunctions and Prepositions; Sentence Patterns in English. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; Organizing seminars and conferences.

Practical

Structural Grammar: Exercises in word classes, identification and study of verbs in sentences, application of tenses and voice, exercises in conjunctions and prepositions, other structural grammar exercises, report writing, letter writing (different types of letters). Spoken English: Conversations of everyday life, the concept of stress: stress shift. Silent letters in words, basic intonation patterns, preparing and address, individual and group presentations, impromptu presentation, public speaking and Group discussion.

Suggested reading

Balasubramanian T. 1989. *A Text book of Phonetics for Indian Students.* Orient Longman, New Delhi.

Balasubrmanyam M. 1985. *Business Communication.* Vani Educational Books, New Delhi.

Bharati T, Hariprasad M and Prakasam V. *Personality Development and Communicative English.* Neelkamal Publications Pvt. Ltd, New Delhi.

Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.

Covey Stephen R. 1989. *The Seven Habits of Highly Successful People*. Free Press.

Krishnaswamy,. N and Sriraman, T. 1995. *Current English for Colleges*. Macmillan India Ltd. Madras.

Krishna M and Banerjee M. 1990. *Developing Communication Skills*. Macmillan India Ltd. New Delhi.

Narayanaswamy V R. 1979. *Strengthen Your Writing*. Orient Longman, New Delhi.

Naterop J B and Rod R. 1997. *Telephoning in English*. Cambridge University Press, Cambridge.

Raymond M. *English Grammar in Use.* Cambridge University Press

Sharma R C and Mohan K. 1978. *Business Correspondence*. Tata Mc Graw Hill Publishing Company, New Delhi.

Spitzberg B, Barge K and Morreale S P. 2006. *Human Communication: Motivation, Knowledge & Skills*. Wadsworth.

The Official Guide to the TOEFL Test-IV Edition, Educational Testing Services. McGraw Hill, New Delhi.

Verma, K C. 2013. *The Art of Communication.* Kalpaz.

Wren and Martin S. *Key to High School English Grammar and Composition*- Chand and Company Ltd., New Delhi

BSB-001 INTRODUCTORY BOTANY (2+1) NC

Theory

Introduction to Botany and general classification of plants. Parts of a typical flowering plant. Morphology of root, stem, leaf and flower. Structure and types of plant tissues. Internal structure of dicot and monocot stems, roots and a typical leaf. Significance of life style with special reference to alternation of generations in *Chlamydomonas, Rhizopus, Funaria, Adiantum, Pinus* and a flowering plant. Importance of platns in relation to environments.

Practical

Morphological studies of roots, stems, leaves and flowers. Studies of permanent slides of histology and anatomy. Morphological studies of gametophytes and sporophytes of the plants pertaining to the life cycle. General survey of the local vegetation . A field trip during the semester.

Suggested reading

Bhatia K N and Widge S S. *Elementary Botany.* Modest Printers, Jallandhar.

Bhatia K N and Widge S S. *Elementary Botany* (New Style) Vol. II. Trueman Book Company, Old Railway Road, Jallandhar.

Dutta A C. *A Class book of Botany.* Oxford University Press USA.

Dutta A C. *Botany for Degree Student* (20th Ed) Oxford University Press USA.

NCERT. *Biology Textbook for Class XI and XII*, NCERT, New Delhi.

BSM-001 BASIC MATHEMATICS (3+0)

Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combination. Binomial theorem for positive integral index, any index and their applications. Addition and subtraction formulae. A, B and C, D formulae. Sine and Cosine formulae. Inverse trigonometric functions. Introduction to matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices. Inverse of a matrix solution of system of linear equations using Cramer's rule and matrices method.

Suggested reading

Mohindra, J P. Models ABC of Mathematics.

PED-001 PHYSICAL AND HEALTH EDUCATION (0+1)

Practical

Physical Education: Introduction to physical education. Posture, exercise for good posture, physical fitness exercises for agility, strength, coordination, endurance and speed. Rules are regulations of important games, skill development in any one of the games – football, hockey, cricket, volleyball, ball badminton, throw ball, tennikoit. Participation in one of the indoor games – shuttle badminton, chess and table tennis. Rules and regulations of athletic events, participation in any one of the athletic events – broad jump, high jump, triple jump, javelin throw, discuss throw, shot put, short and long distance running, Safety education, movement education, effective way of doing day-today activities. First-aid training, coaching for major games and indoor games. Asans and indigenous ways for physical fitness and curative exercises. Exercises and games for leisure time, use and experience. Importance of Asanas and Surya namaskar. Free hand exercises and Yoga. Recreation: definition, agencies promoting recreation, camping and recreation. Note: Warming up and conditioning exercises are compulsory before the commencement of each class.

Suggested reading

Aneja O P. *Encyclopaedia of Physical Education, Sports and Exercise Science* (4 volumes).

Sharma A. *Encyclopaedia of Health and Physical Education* (7 Volumes).

Chaudhery N V and Jain R. *Encyclopedia of Yoga Health and Physical Education* (7 Volumes).

Edwin F Bryant. *Yoga Sutrap of Patanjali*.

Modak P, Sharma O P and Jain D. *Encyclopaedia of Sports and Games with Latest Rules and Regulations* (8 volumes).

ORI-001 ORIENTATION (1+0)

Theory

Relevance of agriculture / horticulture; food and nutritional security (green / white / golden revolution), history of agricultural education in India,; establishment of agricultural and horticultural universities (SAUs) - land grant pattern of USA; ICAR and its functions; organizational set-up and profile of YSPUHF; academic regulations – general terminology, registration, introduction to course curriculum, credit system and credit load, examination and evaluation, calculation of OGPA ; awards and scholarships ; advisement; conduct, discipline, penalties, etc.,

NATIONAL SERVICE SCHEME/NATIONAL CADET CORPS (0+1)

Practical

NSS: Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five year plan. Functional literacy, non-formal education of rural youth, eradication of social evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition. NCC: Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush, field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self-defense, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defense, leadership and NCC song.

SEMESTER-II

VSC-121 TROPICAL AND SUB-TROPICAL VEGETABLE CROPS 2+1

Theory

Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield, post-harvest handling, economics and marketing of tropical and sub-

tropical vegetable crops such as tomato, brinjal, chillies, capsicum, okra, amaranthus, cluster beans, cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, portulaca, basella, sorrel and roselle.

Practical

Identification and description of tropical and sub-tropical vegetable crops; nursery practices and transplanting, preparation of field and sowing/planting for direct sown and planted vegetable crops. Herbicide use in vegetable culture; top dressing of fertilizers and intercultural; use of growth regulators; identification of nutrient deficiencies. Physiological disorder. Harvest indices and maturity standards, post-harvest handling and storage, marketing, seed extraction (cost of cultivation for tropical and sub-tropical vegetable crops), project preparation for commercial cultivation.

Suggested reading

Bose T K. 2002.*Vegetable Crops*. Nayaprakash. Kolkata

Chadha K L. 1993. *Advances in Horticulture*. Malhotra Publishing House. New Delhi

Choudhary B R. 2009. *A Text book on Production Technology of Vegetables*. Kalyani Publishers. Ludhiana.

Choudhury B. (ICAR). 1990. Vegetables. 8th Edition, National Book Trust, New Delhi.

Dhaliwal M S. 2008. *Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana

Gopal Krishnan T R. 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.

Hazra P. 2006.*Vegetable Science*. Kalyani Publishers. Ludhiana

Hazra P. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.

Kamath K V. 2007.*Vegetable Crop Production*. Oxford Book Company. Jaipur

Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi

Sharma P. 2007. *Vegetables : Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur

Velayudhan P S and Singh D P. 1987. *Vegetables for the Tropical Region*. ICAR, New Delhi.

Rana M K. 2008.*Olericulture in India*. Kalyani Publishers. Ludhiana

Shanmugavelu K G. 1989. *Production Technology of Vegetable Crops*. Oxford &IBH Publishing Co. Pvt. Ltd, New Delhi.

Singh D K. 2007. *Modern Vegetable Varieties and Production*. IBN publishers, Technology International Book Distributing Co, Lucknow.

Singh Umashankar. 2008. *Indian Vegetables*. Anmol Publications. Pvt.Ltd .New Delhi.

Thamburaj S. 2014. *Text Book of Vegetable, Tuber Crops and Spices*. ICAR, New Delhi

Uma Shankar. 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.

Yawalkar K S. 2008. *Vegetable Crops in India*. Agri-Horticultural Pub. House. Nagpur. 2004

NRS-121 SOIL FERTILITY AND NUTRIENT MANAGEMENT 1+1

Theory

Introduction to soil fertility and productivity- factors affecting. Essential plant nutrient elements-functions, deficiency systems, transformations and availability. Acid, calcareous and salt affected soils – characteristics and management. Soil organic matter, Role of microorganisms in organic matter- decomposition – humus formation. Importance of C:N ratio and pH in plant nutrition, soil buffering capacity. Integrated plant nutrient management. Soil fertility evaluation methods, critical limits of plant nutrient elements and hunger signs. NPK fertilizers: composition and application methodology, luxury consumption, nutrient interactions, deficiency symptoms, visual diagnosis. Plant nutrient toxicity symptoms and remedies measures. Soil test crop response and targeted yield concept. Biofertilizer. Nutrient use efficiency and management. Secondary and micronutrient fertilizer. Fertilizer control order. Manures and fertilizers classification and manufacturing process. Properties and fate of major and micronutrient in soils. Fertilizer use efficiency and management. Effect of potential toxic elements in soil productivity.

Practical

Analysis of soil for organic matter, available N,P,K and Micronutrients and interpretations. Gypsum requirement of saline and alkali soils. Lime requirement of acid soils. Estimation of organic carbon content in soil. Determination of Boron and chlorine content In soil. Determination of Calcium, Magnesium and Sulphur in soil. Sampling of organic manure and fertilizer for chemical analysis. Physical properties of organic manure and fertilizers. Total nitrogen in urea and farmyard manure. Estimation of ammonical nitrogen and nitrate nitrogen in ammonical fertilizer. Estimation of water soluble P_2O_5, Ca and S in SSP, Lime and Gypsum. Estimation of Potassium in MOP/SOP and Zinc in zinc sulphate. Visiting of fertilizer testing laboratory.

Suggested reading

Basak R K. 2000. *Fertilizers A Text book.* Kalyani publishers, New Delhi.

Brady N C and Weil R R. 2010. *Elements of the Nature and Properties of Soils* (3rd Edition.), Pearson Education, New Delhi.

Das D K. 2011. *Introductory Soil Science* (3rd Edition), Kalyani Publisher, Ludhiana (India).

Fertilizer control order. 1985. The fertilizer Association of India, Shaheed Jit singh marg, New Delhi.

Havlin *et al.* 2014. *Soil Fertility and Fertilizers: An Introduction to Nutrient Management* (8th Edition), PHI Learning Pvt. Ltd., Delhi.

Indian Society of Soil Science, 2002. *Fundamentals of Soil Science*. Indian Society of Soil Science, IARI, New Delhi.

Kanwar J S. (Ed). 1976. *Soil Fertility: Theory and Practice*, ICAR, New Delhi.

Mengel, *et al.* 2001. *Principles of Plant Nutrition* (5th Edition), Springer.

Seetharaman S, Biswas B C, Yadav D S and Matheswaru S U. 1996. *Hand Book on Fertilizers*. Oxford and IBH Publishing Company, New Delhi.

Tandon H L S. 1994. *Fertilizers Guide.* Fertilizers Development Consultation Organization, New Delhi.

Tisdale S L, Nelson W L and Beaton J D. 1993. *Soil Fertility and Fertilizers*. Macmillan Publishing Company, New York.

Yawalkar K S, Agarwal J P and Bokde S. 1992. *Manures and Fertilizers*. Agri. Horticultural Publishing House, Nagpur.

ENS-121 Environmental Studies and Disaster Management 2+1

Theory

Environmental studies: Definition, scope and importance, Natural Resources, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Ecosystems-Concept of an ecosystem, Structure and function of an ecosystem, Biodiversity and its conservation, Environmental Pollution (soil, water, air, noise), Solid Waste Management, Social Issues, Environmental ethics, Wasteland reclamation, Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Issues involved in enforcement of environmental legislation. Public awareness, Environment and human health, Women and Child Welfare, Natural Disasters, Man Made Disasters, Disaster Management

Practical

Field work: Study of renewable energy systems. Visit to a local area to document environmental assets river/ horticulture crop production/ grassland/ hill/ mountain, visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural, Study and documentation of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

Suggested reading

Ahluwalia VK and Malhotra S. 2006. *Environmental Science*. Ane Books India.

Anjaneyulu Y. 2004. *Introduction to Environmental Science*. BS Publications.

Bernard J, Nebel and Richard T Wright.1993. *Environmental Science: The Way the World Works*. Prentice-Hall Professional, New Delhi.

Bharucha Erach. 2005. *Text Book of Environmental Studies for Undergraduate Courses*. University Grants Commission, University Press, Hyderabad.

Chary M and Reddy J R. 2004. *Principles of Environmental Studies*. BS Publishers, Hyderabad.

Chauhan A S. 2009. *Environmental Studies*. 3rd Edition. Jain Brothers.

Climate change. 1995: *Adaptation and mitigation of climate change-Scientific Technical Analysis* Cambridge University Press, Cambridge.

Das RC and Behera DK. 2008. *Environmental Science - Principles and Practice*. Prentice –Hall of India Pvt Ltd.

Dhaliwal G S and Kukal S S. 2005. *Essentials of Environment Science*. Kalyani Publishers. Santra

Gilbert M, Masters and Wendell P. Ela. 2013. *Introduction to Environmental Engineering and Science*. Pearson Education Limited, NY, USA.

Gupta P K. 2004. *Methods in Environmental Analysis – Water, Soil and Air*. Agrobios, Jodhpur.

Husain Majid. 2013. *Environment and Ecology: Biodiversity, Climate Change and Disaster Management*. online book.
Kaul S N and Gautam A. 2002. *Water and Waste Water Analysis*. Days Publishing House, Delhi.
Sharma J P. 2003. *Introduction to Environment Science*. Lakshmi Publications.
Sharma R K and Sharma G. 2005. *Natural Disaster*. APH Publishing Corporation, New Delhi.
Suresh K and Dhameja. 2009. *Environmental Engineering and Management*. S. K. Kataria & Sons, New Delhi.

PHT-121 FUNDAMENTALS OF FOOD AND NUTRITION 1+1

Theory

Food and its functions; Physico-chemical properties of foods; Food preparation techniques; Nutrition and relation of nutrition to good health. Characteristics of well and malnourished population; Energy- Definition, determination of energy requirements, determination of food energy and total energy needs of the body; Carbohydrates – Classification, properties, functions, sources and requirements; Carbohydrates –Digestion, absorption and utilization; Protein- classification, properties, functions, sources, requirements, essential and non-essential amino acids; Protein – digestion and absorption, Quality of proteins –PER, NPR, NPU etc, supplementary value of proteins and deficiency diseases; Lipids –classification, properties, functions, sources, requirements. Saturated and unsaturated fatty acids; Lipids – Digestion, absorption and utilization and deficiency diseases; Mineral- nutrition, macro and micro- minerals (Ca, Fe and P), functions, sources, requirements and deficiency diseases; Micro minerals– functions, sources, requirements and deficiency diseases; Vitamins– functions, sources, requirements and deficiency diseases; Balanced diet, Recommended dietary allowances for various age groups Assessment of nutritional status of the population.

Practical

Evaluation of quality attributes; Methods of measuring food ingredients; Effect of cooking on volume and weight; Determination of percentage of edible portion of food stuffs; Browning reactions of Fruits and Vegetables; Microscopic examination of starches; Estimation of energy value of Foods; Estimation of protein value and fat value of foods; Planning diet for various age groups.

Suggested reading

Anita T. 1996. Food and Nutrition, 3rd Edition. Oxford, 198327668
Gopalan G, Ramasastri B V and Balasubramnian S C. 1996. *Nutritive value of Indian Foods*. National Institute of Nutrition, ICMR, Hydrabad- 500007, India
Kumud K, Gupta S, Jain S, Seth R, Mahna R and Puri S. 2005. *Textbook of Nitrition and Dietetics*. Elite Publishing Home Pvt Ltd., Ansari Road, New Delhi- 1100 002.
Manoranjan K and Sangita S. 1996. *Food Preservation and Processing*. Kalyani Publishers.
Mudambi S R and Rajagopal M V. 1990. *Fundamentals of Food and Nutrition*, 3rd Edition. New Age International Publishers, (P) Ltd., Publishers. New Delhi-110 002

Mudambi S R and Rajagopal M V. 2009. *Fundamentals of Food, Nutrition and Diet Therapy*. New Age International Publishers, (P) Ltd., Publishers. New Delhi-110 002

Shakuntala Manay N and Shadaksharaswamy M. 2001. *Foods- facts and Principles*, 2nd Edition. New Age International (P) Ltd., Publishers. New Delhi-110 002

Swaminathan M. 1985. *Food and Nutrition*, Vol 1 & 2. BAPPCO, Bangalore.

FSC-121 TEMPERATE FRUIT CROPS 2+1

Theory

Classification of temperate fruits, detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self-incompatibility and pollinisers, use of growth regulators, nutrient and weed management, harvesting, post-harvest handling and storage of apple, pear, peach, apricot, plum, cherry, persimmon, strawberry, kiwi, almond, walnut, pecan nut, hazel nut and chest nut. Re-plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures.

Practical

Nursery management practices, description and identification of varieties of above crops, manuring and fertilization, planting systems, Orchard floor management, preparation and use of growth regulators, training and pruning in apple, pear, plum, peach and nut crops. Visit to private orchards to diagnose maladies. Working out economics for apple, pear, plum and peach.

Suggested reading

Banday F A and Sharma M K. 2010. *Advances in Temperate Fruit Production*. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana-141008.

Chadha T R. 2001. *Text Book of Temperate Fruits*. Indian Council of Agricultural Research, New Delhi.

Chattopadhya T K. 2000. *A Text Book on Pomology (Temperate Fruits)* Vol. IV Kalyani Publishers, Hyderabad.

Chattopadhyay T K. 2009. *A text book on Pomology-IV Devoted to Temperate fruits*. Kalyani Publishers.B-1/292,Rajinder Nagar,Ludhiana-141008

Das B.C and Das S N. *Cultivation of Minor Fruits*. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana-141008.

David J and Laone N E. 1999. *Subtropical and Temperate Fruit Production*. CABI, Publications.

Dhillon W S. 2013. *Fruit Production in India*. Narendra Publishing House. New Delhi.

Misra K K. 2014. *Text book of Advanced Pomology. Biotech Books*.4762-63, Ansari Road, Darya Ganj, New delhi-11002.

Mitra S K, Rathore D S and Bose T K. 1992. *Temperate Fruit Crops*. Horticulture and Allied Publishers, Calcutta.

FSC-122 TROPICAL AND SUB-TROPICAL FRUITS **2+1**

Theory

Horticultural classification of fruits including genome classification. Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. Mango, , banana, grapes, citrus, papaya, sapota, guava, pineapple, jackfruit, avocado, mangosteen, litchi, carambola, durian, rambutan, bilimbi, loquat, rose apple breadfruit and passion fruit. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and kokkan disease in banana, citrus decline and casual factors and their management. Bud forecasting in grapes, sex expression and seed production in papaya, latex extraction and crude papain production, economic of production.

Practical

Description and identification of varieties based on flower and fruit morphology in above crops. Training and pruning of grapes, mango, guava and citrus. Selection of site and planting system, pre-treatment of banana suckers, desuckering in banana, sex forms in papaya. Use of plastics in fruit production. Visit to commercial orchards and diagnosis of maladies. Manure and fertilizer application including bio-fertilizer in fruit crops, preparation and application of growth regulators in banana, grapes and mango. Seed production in papaya, latex extraction and preparation of crude papain. Ripening of fruits, grading and packaging, production economics for tropical and sub-tropical fruits. Mapping of arid and semi-arid zones of India. Botanical description and identification of ber, fig, jamun, pomegranate, carissa, phalsa, wood apple, West Indian cherry, tamarind, aonla, bael and annona.

Suggested reading

Bose T K, Mitra S K and Sanyal D. 2002. *Tropical and Sub-Tropical*-Vol-I. Nayaudyog-Kolkata

Chadda K L. 2009. *Advances in Horticulture*. Malhotra Publishing House, New Delhi.

Chadha K L. 2002, 2001. *Hand book of Horticulture*. ICAR, New Delhi.

Chattopadhyay T K. 1997. *Text book on pomology*. Kalyani Publishers, New Delhi.

Chundawat B S. 1990. *Arid fruit culture*. Oxford and IBH, New Delhi.

Dhillon W S. 2013. *Fruit Productionin India.* Narendra Publishing House, New Delhi

Ladaniya M S. 2013. *Citrus Fruits*. Elsevier, India post ltd.

Litz R E. 2009. *The Mango* 2nd Edn. Cabi Publishing, Willingford, U.K.

Rajput C B S and Srihari Babu R. 1985. *Citriculture*. Kalyani Publishers, New Delhi.

Singh H P and Mustafa M M. 2009. *Banana*-new innovations. Westville PublishingHouse, New Delhi.

Singh S P. 2004. *Commercial fruits.* Kalyani Publishers, New Delhi.

Symmonds, 1996. *Banana.* II Edn. Longman, London.

NRS-122 WATER MANAGEMENT IN HORTICULTURAL CROPS 1+1

Theory

Importance of water, water resources in India. Area of different crops under irrigation, function of water for plant growth, effect of moisture stress on crop growth. Available and unavailable soil moisture – distribution of soil moisture – water budgeting – rooting characteristics – moisture extraction pattern. Water requirement of horticultural crops – lysimeter studies – Plant water potential climatological approach – use of pan evaporimeter – factor for crop growth stages – critical stages of crop growth for irrigation. Irrigation scheduling – different approaches – methods of irrigation – surface and sub-surface pressurized methods viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water. Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops. Layout of different irrigation systems, drip, sprinkler. Layout of underground pipeline system.

Practical

Measurements of irrigation water by using water measuring devices, use of common formula in irrigation practices, practicing of land leveling and land shaping implements, layout for different methods of irrigation. Estimation of soil moisture constants and soil moisture by using different, methods and instruments, scheduling of irrigation, different approaches, practicing use of instruments, estimation of irrigation efficiency and water requirements of horticultural crops, irrigation planning and scheduling, soil moisture conservation practices.

Suggested reading

Carr M K V and Elias F. 2012. *Advances in Irrigation Agronomy*. Cambridge University Press.

Michael A M. 2015. *Irrigation Theory and practices*. Vikas publishing house Pvt., Ltd.

Mujmdar D K. 2004. *Irrigation water management: Principles and Practices*. Prentice Hall of India Pvt. Ltd.,

Patil S V and Rajakumar G R. 2016. *Water Management in Agriculture and Horticultural Crops*. Satish serial publishing House, Delhi.

Rao Y P and Bhaskar S R. 2008. *Irrigation technology. Theory and practice*. Agrotech publishing Academy, Udaipur.

Sharma P K. 2017. Introduction to Soil Physics. 528 p, Westville Publishing House, New Delhi.

FSC-123 FUNDAMENTALS OF PLANT BREEDING 2+1

Theory

Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, quantitative and molecular, Plant Breeding in India – limitations, major achievements, goal setting for future. Sexual reproduction (cross and self-pollination), asexual reproduction, pollination control mechanism (incompatibility and sterility and implications of reproductive systems on population structure). Genetic components of polygenic variation and breeding strategies, selection as a basis of crop breeding. Hybridization and selection – goals of hybridization, selection of plants; population developed by hybridization – simple crosses, bulk crosses and complex crosses. General and special breeding techniques. Heterosis – concepts, estimation and its genetic basis. Breeding for resistance of biotic and abiotic stresses. Polyploidy breeding. Mutation breeding.

Practical

Determination of mode of reproduction in crop plants, handling of breeding material, segregating generations (pedigree, bulk and back cross methods), Field layout, and maintenance of experimental records in self and cross pollinated crops. Demonstration of hybrid variation and production techniques.

Suggested reading

Allard R W.1981. *Principles of Plant Breeding*. John Wiley & Sons, New York.

Chopra V L. 2004. *Plant Breeding: Theory and Practice*. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi

Chopra V L. 2001. *Breeding Field Crops*. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.

Gupta S K. 2005.*Practical Plant Breeding*. Agribios.

Pohlman J M and Bothakur D N. 1972. *Breeding Asian Field Crops*. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.

Roy D. 2003. *Plant Breeding, Analysis and Exploitation of Variation*. Narosa Publication House.

Sharma J R. *Principles and Practices of Plant Breeding*. Tata McGraw Publishing Company Ltd., New Delhi

Simmonds N W.1990. *Principles of Crop Improvement*. English Language Book Socity.

Singh B D. 2006. *Plant Breeding*. Kalyani. India.

Singh P.2002. *Objective Genetics and Plant Breeding*. Kalyani Publishers, Ludhiana.

Singh P 2006. *Essentials of Plant Breeding*. Kalyani Publishers, Ludhiana.

Singh S and Pawar I S. 2006. *Genetic Bases and Methods of Plant Breeding*. CBS.

FSC-124 DRYLAND HORTICULTURE **1+1**

Theory

Definition, importance and limitation of dry land horticulture, present status and future scope. Constraints encounter in dry lands. Agro-climatic features in rain shadow areas, scarse water resources, high temperature, soil erosion, run-off losses etc.

Techniques and management of dry land horticulture. Watershed development, soil and water conservation methods-terraces, contour bunds,etc. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits,etc.,*in-situ* water harvesting methods, micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, use of shelter belts, mulches, antitranspirants, growth regulators, and etc. water use efficiency-need based economic and conjunctive use of water, micro systems of irrigation etc. Selection of plants having drought resistance. Special techniques, planting and after care-use of seedling races, root stocks, *in-situ* grafting, deep pitting/planting, canopy management etc.

Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

Practical

Study of rainfall patterns. Contour bunding/trenching, micro catchments, soil erosion and its control. Study of evapotranspiration, mulches and micro irrigation systems. Special techniques of planting and aftercare in dry lands. Study of morphological and anatomical features of drought tolerant fruit crops.

Suggested reading

Chundawat B S. 1990. *Arid Fruit Culture*. Oxford and IBH, New Delhi.

Kumar P T, Suma B, Bhaskar J and Sathesan K N. 2008. *Management of Horticultural Crops*. New India Publishing Agency

Taroj P L, Vashishtha B B and Dhandar D G. 2004. *Advances in Arid Horticulture*. Internal Book Distributing Co., Lucknow.

NATIONAL SERVICE SCHEME/NATIONAL CADET CORPS **(0+1)**

Practical

NSS: Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five year plan. Functional literacy, non-formal education of rural youth, eradication of social evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition. NCC:

Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush, field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self-defense, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defense, leadership and NCC song.

SEMESTER-III

PPP-211 FUNDAMENTALS OF PLANT PATHOLOGY 2+1

Theory

Introduction to the science of phytopathology, its objectives, scope and historical background. Classification of plant diseases, symptoms, signs, and related terminology. Parasitic causes of plant diseases (fungi, bacteria, viruses, phytoplasma, protozoa, algae and flowering parasitic plants), their characteristics and classification. Non-parasitic causes of plant diseases. Infection process. Survival and dispersal of plant pathogens. Plant disease epidemiology, forecasting and disease assessment. Principles and methods of plant disease management. Integrated plant disease management. Fungicides classification based on chemical nature, Commonly used fungicides, bactericides and nematicides.

Practical

Familiarity with general plant pathological laboratory and field equipments. Study of disease symptoms and signs and host parasite relationship. Identification and isolation of plant pathogens. Koch's postulates. Preparation of fungicidal solutions, slurries, pastes and their applications.

Suggested reading

Agrios G N. 2006. *Plant Pathology*. Elsevier Academic press, London.

Alexopoulos C J, Mims C W and Blackwell M. 1996. *Introduction to Mycology*. Wiley Eastern Ltd., New York.

Dhingra and Sinclair. 1993. *Basic Plant Pathology Methods*. CBS, Publishers & Distributors, New Delhi.

Mandahar C L. 1987. *Introduction to Plant Viruses*. Chand and Co. Pvt. Ltd., New Delhi.

Mehrohtra R S and Agarwal A. *Fundamental of Plant Pathology*.

Mehrotra R S and Aneja K R. 1990. *An Introduction to Mycology*. New Age International (P) Ltd., New Delhi.

Ravichandra N G. 2013. *Fundamentals of Plant Pathology*. PHI Hall of India, New Delhi
Sambamurthy. *A textbook of Plant Pathology*.
Singh R S. 1982. *Plant Pathogens - The Fungi*. Oxford and IBH Publishing Co., New Delhi.
Singh R S. 1989. *Plant Pathogens - The Prokaryotes*.Oxford and IBH Publishing Co., New Delhi.
Singh R S. *Introduction to Principles of Plant Pathology*.

PPE-211 FUNDAMENTALS OF ENTOMOLOGY 2+1

Theory

Introduction to phylum arthropoda. Importance of class Insecta. Insect dominance. History of entomology in India, Importance of entomology in different fields. Definition, division and scope of entomology. Classification of insects upto orders and families of economic importance and their distinguished characters. Metamorphosis. Types of eggs, larvae and pupae. Comparative account of external morphology-types of mouth parts, antennae, legs, wings and genitalia. Structure, function of cuticle & moulting and body segmentation. Types of reproduction. Postembryonic development-eclosion. Anatomy of digestive, circulatory, sensory, respiratory, glandular, excretory, nervous and reproductive systems. Plant mites–morphological features, important families with examples.

Practical

Insect collection and preservation. Identification of important insects. General body organization of insects. Study on morphology of grasshopper or cockroach. Observations on metamorphosis of larvae and pupae Preparation of permanent mounts of mouth parts, antennae, legs and wings. Dissection of grasshopper and caterpillar for study of internal morphology.

Suggested reading

Awasthi V B. 1997. *Introduction to General and Applied Entomology*. Scientific Publishers, Jodhpur, 379p.
Beutel R G Friedrich F, Ge S-Q and Yang X-K 2014. *Insect Morphology and Phylogeny: A Textbook for Students of Entomology*. De Gruyter, Berlin/Boston, 516p
Chapman R F. 1981. *The Insects: Structure and Function*. Edward Arnold (Publishers) Ltd, London, 919p.
Gullan P J and Cranston P S. 2006. *The Insects- An Outline of Entomology*, II edition, Chapman & Hall, Madras, 491p.
Srivastava P D and Singh R P. 1997. *An Introduction to Entomology*, Concept Publishing Company, New Delhi, 269p.
Tembhare D B. 1997. *Modern Entomology*. Himalaya Publishing House, Mumbai, 623p.

BSC-211 ELEMENTARY PLANT BIOCHEMISTRY **1+1**

Theory

Carbohydrates: Occurrence, classification and structure, physical and chemical properties of carbohydrates, isomerism, optical activity, reducing property, reaction with acids and alkalis, ozone formation. Lipids: Classification, important fatty acids and triglycerides, essential fatty acids. Physical and chemical control of oils, their rancidity, phospholipids, types and importance. Plant pigments – structure and function of chlorophyll and carotenoids, sterols, basic structure, role of brassino sterols in plants. Proteins: Classification, function and solubility, amino acids – classification and structure, essential amino acids, properties of amino acids, colour reactions, amphoteric nature and isomerism; structure of proteins –primary, secondary tertiary and quaternary properties and reaction of proteins. Enzymes: Classification and mechanism of action; factors affecting enzyme action, co-factors and coenzymes. Vitamins and minerals as co-enzymes/co-factors. Carbohydrate metabolism – glycolysis and TCA-cycle; metabolism of lipids, fatty acid oxidation, biosynthesis of fatty acids, electron transport chain, bioenergetics of glucose and fatty acids, structure and function of nucleic acid replication, transcription and translation.

Practical

Preparation of standard solutions and reagents; Carbohydrates: Qualitative reactions; Estimation of starch; Estimation of reducing and non reducing sugars from fruits; Amino acids: Reactions of amino acids; Proteins: Estimation of proteins by Lowry's method; Fatty acids: Estimation of free fatty acids; Determination of iodine number of vegetable oils; Vitamins: Estimation of Ascorbic acid; Techniques: Paper chromatography, Thin layer chromatography; Electrophoresis of pigments extracted from flowers, Extraction of oil from oil seeds; Enzymes: Enzyme assay, Enzyme Immobilization.

Suggested reading

Buchanan B B, Gruissem W and Jones R L. 2002. *Biochemistry and Molecular Biology of Plants*. 2nd edition. Blackwell publications, UK.

Lehninger Nelson D L and Michael M C. 2004. *Principles of Biochemistry.* Freeman Publishers

Narayanan L M. *Biochemistry*. Saras Publications

Rameshwar A. 2006. Practical Biochemistry (3rd Ed). Kalyani Publishers, New Delhi.

Sadashiv S and Manickam A. 1996. *Biochemical Methods for Agricultural Sciences*. Newage International Publishers, New Delhi.

Voet D and Voet J G. 2004. Biochemistry (3rd Ed). John Wiley & Sons Incl.USA.

Voet D and Voet J G. 2004. *Biochemistry* (4th Ed). Wiley & Sons Publishers. USA.

NRS-211 FARM POWER AND MACHINERY **1+1**

Theory

Basic concepts of various forms of energy, unit and dimensions of force energy and power, calculations with realistic examples. IC Engines: Basic principles of operation of compression, ignition and spark ignition engines, two stroke and four stroke engines, cooling and lubrication system, power transmission system, broad understanding of performance and efficiency, tractors, power tillers and their types and uses. Electric motors: types, construction and performance comparison. Tillage: objectives, method of ploughing. Primary tillage implements: construction and function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, disc and rotary ploughs. Secondary tillage implements: construction and function of tillers, harrows, levelers, ridgers and bund formers. Sowing and transplanting equipment: seed drills, potato planters, seedling transplanter. Grafting, pruning and training tools and equipment. Inter-culture equipment: sweep. Junior hoe, weeders, long handle weeders. Crop harvesting equipments: potato diggers, fruit pluckers, tapioca puller and hoists.

Practical

Calculation on force, power and energy. IC engines – showing the components of dismantled engines and motors. Primary and secondary tillage implements, hitching, adjustments and operations. Spraying equipment, calibration and operation. Plant protection equipment, calculation of dilution ratio and operation.

Suggested reading

Ghoshal M K and Das D K. 2008. *Farm Power*, Kalyani Publishers.

Jain S C. 2003. *Farm Machinery- An Approach.* Standard Publishers and Distributors, New Delhi

Kepner R A, Bainer R and Barger B L. 1978. *Principles of Farm Machinery*. CBS Publisher and Distributors, Delhi.

Klenin N I, Popov I F and Sakun V A. 1985. *Agricultural Machines*. Amerind Publishing Co. Pvt. Ltd., New Delhi.

Nakra C P. 1986. *Farm Machinery and Equipment*. Dhanpat Rai and Sons, New Delhi

Ojha T P and Michael A M. 2005. *Principles of Agricultural Engineering* (Volume - 1), Jain Brothers

Pandey M M and Others. 2012. *Handbook of Agricultural Engineering*. ICAR publication

Roth and Field. 1992. *Introduction to Agricultural Engineering - Problem Solving Approaches*, 2nd Edition. CBS publishers & distributors Pvt. Ltd.

Sahay J. 1992. *Elementsof Agricultural Engineering*. Agro Book Agency, Patna.

Singh S and Verma. 2009. *Farm Machinery Maintenance & Management*. ICAR Publication.

Singh S. 2007. *Farm Machinery Principles and Applications*. ICAR Publications.

FSC-211 GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS 1+1

Theory

Growth and development-definitions, components, photosynthetic productivity, Canopy photosynthesis and productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, Crop development and dynamics (Case studies of annual/perennial horticultural crops), growth analysis in horticultural crops. Plant bio-regulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factors affecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutral plants, vernalisation and its application in horticulture, pruning and training physiological basis of training and pruning-source and sink relationship, translocation of assimilates. Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops. Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits-climatic and non-climacteric fruits. Physiology of fruits under post-harvest storage.

Practical

Estimation of photosynthetic potential of horticultural crops, leaf area index, growth analysis parameters including harvest index, bioassay of plant hormones, identification of synthetic plant hormones and growth retardants, preparations of hormonal solution and induction of rooting in cuttings, ripening of fruits and control of flower and fruit drop. Important physiological disorders and their remedial measures in fruits and vegetables, seed dormancy, seed germination and breaking seed dormancy with chemicals and growth regulators.

Suggested reading

Basra Amarjit. *Plant Growth Regulators in Agriculture and Horticulture: Their role & Commercial Uses*

Basra, A. S. 2004. *Plant Growth Regulators in Agriculture & Horticulture.* HAWARTH press. New York.

Bleasdale J K A. *Plant Physiology in relation to Horticulture*

Delvin R M. 1986. *Plant Physiology*. CBS. Delhi.

Edward E D. 2014. *Principles of Horticultural Physiology*. CABI, UK.

Jacobs W P. 1979. *Plant Hormones and Plant Development.* Cambridge Univ. London.

Noggle G R and Fritz T G.1944. *Introductory Plant Physiology.*

Pandey and Sinha. *Plant Physiology.*

Rajendran C, Ramamoorthy K and Juliet Hepziba S. *Nutritional and Physiological Disorders in Crop Plants.*

Richard N Arteca. 2004. *Plant Growth Substances*. CBS. New Delhi.

Salisbulry. 2007. *Plant Physiology.* CBS. New Delhi.

Taiz L. 2010. *Plant Physiology*. SINAUR. USA.

Taiz L and Zeiger E. *Plant Physiology*(5th Edition).. Sinauer Associates, Inc.

Zeiger. 2003. *Plant Physiology*. PANIMA. New Delhi.

FLA-211 ORNAMENTAL HORTICULTURE **1+1**

Theory

History, definitions, scope of ornamental horticulture, aesthetic values, Floriculture industry. Importance, area and production, industrial importance of ornamental plants and flowers. Importance, classification, landscape values and general cultivation aspects for ornamental plants *viz.* Annuals, biennials, herbaceous perennials, grasses and bulbous ornamentals, shrubs, climbers, trees, indoor plants, palms & cycads, ferns & sellaginellas, cacti & succulents. Importance, design and establishment of garden features/components viz. hedge, edge, borders, flower beds, bridges, paths, drives, fences, garden walls, gates, carpet bed, arbour, Patio, decking, retaining walls, shade garden, sunken garden, roof garden, terrace garden, pebble garden, rockery, pools, waterfalls, fountains, bog garden, avenue planting and children garden. Lawn types, establishment and maintenance. Importance of Garden adornments viz. floral clock, bird bath, statutes, sculptures, lanterns, water basins, garden benches etc. Uses of vertical garden, bottle garden, terrariums, art of making bonsai, culture of bonsai and maintenance.

Practical

Identification and description of annuals, biennials, herbaceous perennials, climbers, shrubs, trees, indoor plants, ferns and sellagenellas, Palms & cycads and Cacti & succulents. Planning and designing and establishment of garden features viz. lawn, hedge and edge, rockery, water garden, carpet bedding, shade garden, roof garden, Study and creation of terrariums, vertical garden, Study of Bonsai techniques, Bonsai making and training. Visit to nurseries and floriculture units.

Suggested reading

Arora J S. 2006. *Introductory Ornamental Horticulture.* Kalyani Publishers, Ludhiana

Bose T K and Mukherjee D. 2004. *Gardening in India.* Oxford & IBH Publishers.

Bose T K, Chowdhury B and Sharma S P. 1991. *Tropical Garden Plants in Colour.* Horticulture and Allied Publishers, 3D Madhab Chatterjee street Kolkata.

Chadha K L and Chaudhary B. 1986. *Ornamental Horticulture in India.* Publication and Information Division. ICAR, New Delhi.

Chowdhury B and Jana B L. 2014. *Flowering Garden Trees.* Pointer Publishers, Jaipur. India.

Peter K V. 2009. *Ornamental Plants.* New India Publishing Agency, Pitampura, New Delhi.

Randhawa, G S and Mukhopadhyay A. 2004. *Floriculture in India.* Allied Publishers Pvt. Ltd., New Delhi.

Richard Bird. 2002. *Flowering Trees and Shrubs.* Printed in Singapore by Star Standard Industries Pvt. Ltd.

AGRON-211 INTRODUCTION TO MAJOR FIELD CROPS **1+1**

Theory

Classification and distribution of field crops, definitions and concept of multiple cropping, mixed cropping, intercropping, relay and alley cropping, cultural practices for raising major cereals, pulses, oil seeds and fodder crops, green manuring, crop rotation.

Practical

Identification of crop plants, seeds and weeds. Preparation of cropping scheme. Application of herbicides in field crops.

Suggested reading

Bose S C M and Balakrishnan V. 2001. *Forage Production.* South Asian Publishers, New Delhi.

Gurarajan B, Balasubramanian R and Swaminathan V. 2014 *Recent Strategies on Crop Production*. Kalyani Publishers, New Delhi.

Package of Practices for Rabi and Kharif Crops. CSKHPKV, Palampur, www.cskhpkv.nic.in

Reddy S R. 2009. *Agronomy of Field Crops*. Kalyani Publishers, New Delhi.

Singh C. 1997. *Modern Techniques of Raising Field Crops*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Singh S S. 2005. *Crop Management*. Kalyani Publishers, New Delhi.

AGRON 212 Weed Management in Horticultural Crops 2 (1+1)

Theory

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Practical

Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass, parthenium and celosia; Economics of weed control practices; Tours and visits of problem areas.

VSC-211 TEMPERATE VEGETABLE CROPS 1+1

Theory

Importance of cool season vegetable crops in nutrition and national economy. Area, production, export potential, description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of cabbage, cauliflower, knol-khol, sprouting broccoli, Brussels' sprout, lettuce, palak, Chinese cabbage, spinach, garlic, onion,

leek, radish, carrot, turnip, beet root, peas, broad beans, rhubarb, asparagus, globe artichoke. Vegetable kale.

Practical

Identification and description of varieties/hybrids; propagation methods, nursery management: preparation of field, sowing/transplanting; identification of physiological and nutritional disorders and their corrections; post-harvest handling; cost of cultivation and field visits to commercial farms.

Suggested reading

Bose T K. 2002.*Vegetable Crops*. Nayaprakash. Kolkata.

Bose T K. 2003. *Vegetable Crops*. Naya udyog publishers, Kolkata. 2002. Naya Prakash, Calcutta.

Chadha K L. 1993. *Advances in Horticulture*. Malhotra publishing house. New Delhi

Choudhary B R. 2009. *A Text book on production technology of vegetables*. Kalyani Publishers. Ludhiana.

Choudhery B. 1990. *Vegetables*. 8th edition. National Book Trust, New Delhi.

Dhaliwal M S. 2008.*Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana

Gopal Krishnan T R. 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.

Hazra P. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.

Kamath K V. 2007.*Vegetable Crop Production*. Oxford Book Company. Jaipur

Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi

Hazra P. 2006.*Vegetable science*. Kalyani Publishers .Ludhiana

Sharma P. 2007.*Vegetables : Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur

Arya P S. 1999. *Vegetable Seed Production Principles*. Kalyani Publishers, New Delhi.

Rana M K. 2008. *Olericulture in India*. Kalyani Publishers. Ludhiana

Shanmugavelu K G. 1989. *Production Technology of Vegetable Crops*. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

Singh Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt.Ltd .New Delhi.

Thamburaj S. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.

Uma Shankar. 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.

Yawalkar K S. 2004.*Vegetable crops in India*. Agri-Horticultural Pub. House. Nagpur.

VSC-212 SPICES AND CONDIMENTS 2+1

Theory

History, scope and importance, Present status, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and

micropropagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products, methods of extraction of essential oil and oleoresins. Economics of cultivation, role of Spice Board and Pepper. Export Promotion Council, institutions and research centers in R&D. Crops: Cardamom, pepper, betel vine ginger, turmeric, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme and rosemary.

Practical

Identification of varieties: propagation, seed treatment – sowing; layout, planting; hoeing and earthing up; manuring and use of weedicides, training and pruning; fixing maturity standards, harvesting, curing, processing, grading and extraction of essential oils and oleoresins. Visit to commercial plantations.

Suggested reading

Shanmugavelu K G, Kumar N and Peter K V. 2005. *Production Technology of Spices and Plantation Crops*. Agrosis, Jodhpur.

Shanmugavelu K G and Madhava Rao. 1977. *Spices and Plantation Crops*. Madras Popular Book Depot.

Kumar N J B M, Khaddar Md. Abdul, Ranga Swamy P and Irulappan I. 1997. *Introduction to Spices, Plantation Crops, and Aromatic crops*. Oxford & IBH, New Delhi.

Pruthi J S. 1980. *Spices and Condiments*. Academic Press, New York.

Pruthi J S. 1993. *Major Spices of India - Crop Management Postharvest Technology*. ICAR, New Delhi.

Pruthi J S. 2001. *Minor Spices and Condiments - Crop Management Post Harvest Technology*. ICAR, New Delhi.

Purseglove Brown, Green E G, Robbins G Z, London S R J and Longman. 1981. *Spices* Vol.I & II.

PPE-212 Nematode Pests of Horticultural Crops and their Management 1+1

Theory

History and development of nematology - definition, economic importance. General characters of plant parasitic nematodes, their morphology, biology, symptomatology and control of important plant parasitic nematodes of fruits – (tropical, sub-tropical and temperate) vegetables, tuber, ornamental, spice and plantation crops. Role of nematodes in plant disease complex. Integrated nematode management.

Practical

Methods of sampling and extraction of nematodes from soil and plant parts, killing, fixing and preparation of temporary and permanent nematode mounts. Nematicides and their use. Collection and preservation of plant species/parts damaged by plant parasitic nematodes.

Suggested reading

Dasgupta K M. 1998. *Phytonematology*. Naya Prokash, 206 Bidhan Sarani, Calcutta. 846p

Swaroop G and Gupta D. 1986. *Plant Parasitic Nematodes of India Problems and Progress*. ICAR, New Delhi.

Upadhyay K D and Dwivedi K. 1997. *A Text Book of Plant Nematology*. Amman Publishing House Aman publishing house, Meerut

Walia R K and Bajaj H K. 2003. *A Textbook on Introductory Plant Nematology*. ICAR. 218p

NATIONAL SERVICE SCHEME/NATIONAL CADET CORPS (0+1)

Practical

NSS: Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five year plan. Functional literacy, non-formal education of rural youth, eradication of social evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition. NCC: Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush, field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self-defense, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defense, leadership and NCC song.

SEMESTER-IV

NRS-221 SOIL, WATER AND PLANT ANALYSIS 1+1

Theory

Methods of soil and plant sampling and processing for analysis. Characterization of hydraulic mobility – diffusion and mass flow. Renewal of gases in soil and their abundance. Methods of estimation of oxygen diffusion rate and redox potential. Use of radio tracer techniques in soil

fertility evaluation. Soil micro-organisms and their importance. Saline, alkali, acid, waterlogged and sandy soils, their appraisal and management. Chemical and mineral composition of horticultural crops. Leaf analysis standards, index tissue, interpretation of leaf analysis values Quality of irrigation water. Radio tracer technology application in plant nutrient studies. Rapid tissue tests for soil and plant. Management of poor quality irrigation water in crop management. Soil and Water pollution.

Practical

Introduction to analytical chemistry, Collection and preparation of soil, water and plant samples for analysis. Determination of pH, electrical conductivity, sodium adsorption ratio and exchangeable sodium percentage of soils. Estimation of available macro and micronutrient elements in soils and their contents in plants. Irrigation water quality analysis. Determination of pH and EC in irrigation water samples, Determination of Carbonates and bicarbonates in soil and irrigation water, Determination of Calcium and Magnesium in soil and irrigation water. Determination of N, P, K, Ca, Mg, Sand micronutrients in plant samples. Determination of Sodium, Potassium, Chlorine and Boron in irrigation water.

Suggested reading

Tandon H L S. 2013. *Methods of Analysis of Soil, Plant, Water and Fertilizers*. FDCO, New Delhi.

Yawalkar K S, Agarwal J P and Bokde S. 1977. *Manures and Fertilizers*. Agri-Horticultural Publishing House, Nagpur.

Jaiswal P C. 2006. *Soil, Plant and Water Analysis* (2nd Edition), Kalyani Publishers, Ludhiana.

Jackson M L. 1967. *Soil Chemical Analysis*, Oxford and IBH Publishing Co., New Delhi.

Richards L A. 1968. *Diagnosis and Improvement of Saline and Alkaline Soils*. Oxford and IBH publishing Co. New Delhi(USDA Hand Book No. 60)

Chopra S C and Kanwar J S. 1976. *Analytical Agricultural Chemistry*, Kalyani Publishers, Ludhiana.

Piper C S. 2014, *Soil and Plant Analysis*, Scientific publishers India.

Gupta P K. 2013, *Soil, Plant, Water and Fertilizer Analysis*. Agrobios, India.

Durai M V. 2014, *Hand book of Soil, Plant, Water, Fertilizers and Manure Analysis*. New India publishing agency.

NRE-221 INTRODUCTORY ECONOMICS AND MARKETING 2+1

Theory

Nature and scope of economics, definition and concepts, divisions of economics, economic systems, approaches to the study of economics. Consumption – theory of consumer behaviour, laws of consumption, classification of goods. Wants – their characteristics and classification,

utility and its measurement, cardinal and ordinal, law of diminishing marginal utility, law of equi-marginal utility, indifference curve and its properties, consumer equilibrium. Theory of demand, demand schedule and curve, market demand. Price, income and cross elasticities. Engil's law of family expenditure – consumer's surplus. Theory of firm, factors of production – land and its characteristics, labour and division of labour, theories of population. Capital and its characteristics – classification and capital formation. Enterprises – forms of business organization – merits and demerits. Laws or return – law of diminishing marginal return – cost concepts. Law of supply – supply schedule and curve elasticities. Market equilibrium, distribution – theories of rent, wage, interest and profit. Price determination and forecasting under various market structures. Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets – Marketing of various channels – Price spread – Marketing Efficiency – Integration – Constraints in marketing of agricultural produce. Market intelligence – Basic guidelines for preparation of project reports- Bank norms – Insurance – SWOT analysis – Crisis management.

Practical

Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Identification of marketing channel– Calculation of Price Spread – Identification of Market Structure – Visit to different Markets.

Suggested reading

Acharya S S and Agarwal N L. 2005. *Agricultural Marketing in India*. Oxford and IBH Publishing Co. Pvt. Ltd.

Ahuja H L. *Advanced Economic Theory*. Micro Economic Analysis. Chand S. and Company Limited.

Aswathappa. *International Business*. Tata McGraw-Hill Education, New Delhi

Chandra P. 1984. *Projects: Preparation, Appraisal & Implementation*. McGraw Hill Inc.

Dewett K K and Chand A.1979. *Modern Economic Theory*. S.Chand and Co., New Delhi.

Dewett K K and Varma J D. 1986. Elementary Economics. S.Chand and Co., New Delhi.

Fransis Cherunilam. *International Business: Text and Cases*, 5th Ed. PHI Learning, New Delhi.

Gopalakrishnan P and Rama Moorthy V E. *Textbook of Project Management*. Macmillan.

Gupta R D and Lekhi R K. 1982. *Elementary Economic Theory*. Kalyani Publishers.

Harold Kerzner. *Project Management – A System Approach to Planning, Scheduling, and Controlling*. CBS Publishers & Distributors.

Jhingan M L. 2012. Macro Economic Theory. Vrinda publishers, New Delhi .

John Daniels, Lee Radebaugh, Brigham and Daniel Sullivan. *International Business*, 15th Ed., Pearson Education.

John M Nicholas. *Project Management for Business and Technology* – Principles and Practices. Pearson Prentice Hall.

Kotler P and Armstrong. *Principles of Marketing*. Prentice-Hall.

Chandra P. *Projects – Planning, Analysis, Selection, Financing, Implementation, and Review.* Tata McGraw-Hill Publishing Company Ltd.
Chandra P. *Projects.* Tata McGraw-Hill Pu blication, New Delhi
Mukherjee S. 2002. *Modern Economic Theory*. New Age International.
Sontakki C N. *Marketing Management*. Kalyani Publishers, New Delhi.
Reddy S, Raghu Ram S P, Sastry N T V and Devi B I. 2010, *Agricultural Economics*, Oxford & IBH Publishing Co. Private Limited, New Delhi
Willium J S. 1984. *Fundamentals of Marketing*. Tata McGraw-Hill Publication, New Delhi.

FLA-221 FUNDAMENTALS OF LANDSCAPE ARCHITECTURE 1 +1

Theory

Historical Importance of Indian gardens, Gardens of ancient world, Famous gardens of India and abroad, formal, informal, free style and wild gardens, Steps in preparation of garden design. Use of Auto CAD and Arch CAD in designing gardens. Factors affecting landscape design viz. intial approach, view, human choice, simplicity, topography etc., Principles of Landscape designs viz. Axis, rhythm, balance, focal point, mobility, emphasis, unity and harmony etc. Elements of landscape design viz. tangible and intangible elements. Bio-aesthetic planning, definition, objectives, Planning and designing of home gardens, colonies, country planning, urban landscape, Development of institutional gardens, planning and planting of avenues, beautifying schools, railway lines, railway stations, factories, bus stands, air ports corporate buildings, dams, hydro electric stations, river banks, play grounds, Gardens for places of religious importance viz. temples, churches, mosques, tombs etc, Importance, features and establishment of English garden, Japanese gardens, Mughal gardens, French and Persian garden, Italian gardens, Hindu gardens and Buddhist gardens, Xeriscaping.

Practical

Study of garden equipments. Study of Graphic language, Use of drawing equipments, graphic symbols and notations in landscaping designing, Study and designing of different styles of gardens, Study and designing of gardens based on different themes, Designing gardens using Auto-cad/ archi-cad, Designing gardens for home, traffic islands, schools and colleges, public buildings, factories, railway stations, air ports, temples, churches, play grounds, corporate buildings/ malls. Designing and planting of avenues for state and National highways, Design and establishment of Japanese, English and Mughal gardens. Visit to public, institutional and botanical gardens.

Suggested reading

Arora J S. 2006. *Introductory Ornamental Horticulture*. Kalyani Publishers, Ludhiana.
Bhattacharjee S K. 2004. *Landscape Gardening and Design with Plants.* Avishkar Publishers Distributers, Jaipur.

Bose T K, Maiti R G, Dhua R S and Das P. 2004. *Floriculture and Landscaping*. Nayaprakash, Calcutta.

De L C. 2013. *Nursery and Landscaping*.. Pointer Publishers, Jaipur, India.

Grewal H S and Singh P. 2014. *Landscape Designing and Ornamental Plants*. Kalyani Publishers, Ludhiana.

Randhawa G S and Mukhopadhyay A. 2004. *Floriculture in India*. Allied Publishers Pvt. Ltd., New Delhi.

Roy R K. 2013. *Fundamentals of Garden Designing*. New India Publishing Agency, Pitampura, New Delhi.

Srivastava R. 2014. *Fundamentals of Garden Designing*. Agrotech Press, Jaipur, New Delhi.

Tiwari A K. and Kumar R. 2012. *Fundamentals of Ornamental Horticulture and Landscape Gardening*. New India.

PPE-221 Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops 2+1

Theory

General – economic classification of insects; Bio-ecology and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops; pest surveillance. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub-tropical and temperate fruits, plantation crops like coconut, areca nut, oil palm, cashew, cacao, tea, coffee, cinchona, rubber; medicinal and aromatic crop spp (Ashwagandha, Coleus, Isabgol, opium, periwinkle, serpentine, *Rauvolfia*, long pepper, basil, patchouli, jasmine, mint, citronella, davana). Storage insects – distribution, host range, bio-ecology, injury, integrated management of important insect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processed products. Insecticide residue problems in fruit crops and their maximum residue limits (MRLs).

Practical

Study of symptoms of damage, collection, identification, preservation, assessment of damage and population of important insect – pests affecting fruits, plantation, medicinal and aromatic crops in field and storage.

Suggested reading

Atwal A S and Dhaliwal G S. 2015. *Agricultural Pests of South Asia*. Kalyani Publishers, Ludhiana. 678p.

Butani D K.1984. *Insects and Fruits*. Periodical Expert Book Agency, New Delhi.

Sharma R. *Identification and Management of Horticulture Pests*. Fryer. Insect pest of fruit crops.

Ranjit P. 2012. *Entomological Techniques in Horticultural Crops*, New India Publishing Agency.

Reddy P P. 2010. *Plant Protection in Horticulture* Vol. 1, 2 & 3, Scientific Publishers, Jodhpur.

PPP-221 Diseases of Fruit, Plantation, Medicinal and Aromatic Crops 2+1

Theory

Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases of fruits, plantation, medicinal and aromatic crops *viz* mango (malformation, powdery mildew, anthracnose, dieback, and bacterial canker), banana (Panama disease, Moko wilt, Sigatoka leaf spot, anthracnose, bunchy top, stem end rot), grape (powdery mildew, downy mildew, anthracnose, black rot, bacterial canker), citrus (gummosis, powdery mildew, scab, canker, citrus tristeza/citrus decline, citrus greening), guava (wilt, fruit canker, stem canker, anthracnose, red rust), sapota (leaf spot, flat limb, sooty mould, red rust), papaya (powdery mildew, leaf blight, damping off, foot rot, anthracnose, papaya mosaic, leaf curl, papaya ring spot),jack fruit (die back, fruit rots, leaf spot, pink disease), pineapple (heart rot, base rot, wilt, pink disease bacterial fruit rot), pomegranate (bacterial blight, leaf spots, fruit rots), Pyrethrum (Fusarium wilt, leaf spot, root rot, ray blight), ber (powdery mildew, Isariopsismouldy spot, fruit rots, rust), apple (scab, powdery mildew, white root rot, cankers), pear(scab, fire blight, powdery mildew, leaf spots), peach (leaf curl, frosty mildew, gummosis, crown gall, phytoplasma diseases), plum (plum pocket, wilt, bacterial canker, plum pox), almond (blossom blight and brown rot, almond rust, shot hole, leaf scortch), walnut (blight, leaf blotch and anthracnose), strawberry (leaf spots, red stele, grey mould, leather rot), areca nut (Mahli, Anabe, bacterial leaf stripe), coconut (bud rot, Ganodermawilt, cadang-cadang), oil palm (bacterial bud rot, Ganoderma butt rot, Oil palm wilt, Pestalotiopsis leaf spot), coffee (rust, black rot, pink disease, anthracnose, root disease), tea (red rust, blister blight, root rot diseases, black rot), cocoa (seedling die-back, white thread blight, black pod disease, charcoal pod rot, witches broom), cashew (powdery mildew, Leaf and nut blight disease, anthracnose, Dieback/Pink Disease, Cashew wilt, Damping Off of Seedling), rubber (leaf fall, seedling blight, pink disease, root rot disease, Bird's eye spot, pink disease, wilt), betel vine (leaf rot, Pythium foot rot, leaf spot, powdery mildew, bacterial leaf blight, Fusarium wilt, root knot), senna (damping off, leaf spots, leaf blight), neem (powdery mildew, root rot, leaf web blight, leaf spot, bacterial wilt), hemp (leaf spot, wilt, phyllody), belladonna (root rot/wilt, leaf spot, damping off, downy mildew, mottle virus), camphor(powdery mildew, Verticillium wilt, leaf spot, leaf blight), costus (leaf blight, rhizome rot), crotalaria (Fusarium wilt, stem rot), datura (wilt, root and foot rot, leaf spot), dioscorea (damping off, tuber rot, leaf spot, leaf blight), mint (powdery mildew, wilt, rust, leaf spot, stolon rot), opium (damping off, root rot, powdery mildew, capsule rot, leaf blight, poppy mosaic virus, soft rot), *Solanum khasianum* (wilt, Alternaria leaf blight) and Tephrosia (wilt, stem burn). Important post-harvest diseases of fruit, plantation and medicinal and aromatic crops and their management.

Practical

Observations of disease symptoms, identification of casual organisms and host parasite relationship of important diseases. Examination of scrapings and cultures of important pathogens of fruits, plantation, medicinal and aromatic crops.

Suggested reading

Chadha K L. 2002. *Hand Book of Horticulture*. ICAR. New Delhi.

Karthikeyan A and Dinakaran R. 1999. *Diseases of Horticultural Crops*. Department of Plant Pathology, TNAU, Coimbatore.

Kulkarni S H and Yashoda R. 2002. *Diseases of Plantation Crops and Their Management*- Agrotech Publication Academy, 176p.

Pathak V N. 1986. *Diseases of Fruit Crops*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 309p.

Rangaswamy G and Mahadevan A. 2010. *Diseases of Crop Plants in India*, 4th Ed., PHI Learning Pvt. Ltd., New Delhi, 536p.

Singh R S 2005. *Plant Diseases*, 8th Ed., Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 720p.

Verma L R and Sharma R C. 1999. *Diseases of Horticultural Crops*: *Fruits*, Indus Publishing Co., New Delhi, 724p.

ENS-221 AGRO-METEOROLOGY AND CLIMATE SCIENCE 1+1

Theory

Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology. Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate, atmospheric temperature, soil temperature, solar radiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration, monsoons, rainfall, clouds, drought, weather disasters and their management atmospheric pollution and role of meteorology. Basics of weather forecasting. Climate change-causes. Global warming-causes and remote sensing. Effect of climate change on horticulture Past and future changes in greenhouse gases within the atmosphere. Sources and sinks for greenhouse gases. Atmospheric chemistry. Plants sense and respond to changes in CO2 concentration. Measurement of short-term effects and mechanisms underlying the observed responses in C3 and C4 species. plant development affected by growth in elevated CO2. Physiology of rising CO2 on nitrogen use and soil fertility, its implication for production. Methodology for studying effect of CO2. Change in secondary metabolites and pest disease reaction of plants. The mechanisms of ozone and UV damage and tolerance in plants. Increased temperature and plants in tropical/sub-tropical climates- effect on growing season, timing of flowering, duration of fruit development and impacts on crop yields and potential species ranges, interaction of temperature with other abiotic/biotic stress. Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere. Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies.

Practical

Site selection for Agromet observatory; Measurement of temperature; Measurement of rainfall; Measurement of evaporation (atmospheric/soil); Measurement of atmospheric pressure; Measurement of sunshine duration and solar radiation; Measurement of wind direction and speed and relative humidity; Study of weather forecasting and synoptic charts. Visit to Meteorological observatory, Visit to IMD meteorological observatory-Lay out plan of standard meteorological observatory. Recording of air and soil temperature. Measurement of radiation and components, Measurement of rainfall-different types of raingauges, Measurement of wind speed and direction and atmospheric humidity, Recording of evaporation. Synoptic charts and weather reports, symbols, *etc*.

Suggested reading

Lenka D. 2006. *Climate, Weather and Crops in India*. Kalyani Publishers, New Delhi.

Mavi H S and Graeme J Tupper. 2005. *Agrometeorology – Principles and Applications of Climate Studies in Agriculture*. International Book Publishing Co., Lucknow.

Mavi H S. 1994. *Introduction to Agrometeorology*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Mavi H S.1985. *Introduction to Agrometeorology*. Oxford & IBH Publishing Co., NewDelhi.

Nanjappa H V and Ramachandrappa B K. 2007. *Manual on Practical Agricultural Meteorology*. Agrobios India. Jodhpur.

Pattersen S. 1958. *Introduction to Meteorology*. Mc. Graw Hill Book Co.Inc., New York .

Prasad Rao G S L H V. 2008. *Agricultural Meteorology*. Prentice Hall of India Pvt. Ltd., New Delhi.

Reddy S R. 1999. *Principles of Agronomy*. Kalyani Publishers, New Delhi.

Srivastava A K and Tyagi P K. 2011. *Practical Agricultural Meteorology*. New Delhi Publishing Agency, New Delhi.

Tailor J T. 1967. *Agricultural Climatology*. Pergman Press Ltd., Headingt on Hill Hall, Oxford, England

Trewarthe T G. 1968. *An Introduction to Climate*. Mc Graw Hill Book Co.Inc.,NewYork.

Yellamanda T Reddy and Sankara G H Reddi. 2010. *Principles of Agronomy*. Kalyani Publishers, New Delhi.

FSC-221 BREEDING OF FRUIT AND PLANTATION CROPS 2+1

Theory

Fruit breeding - History, importance in fruit production, distribution, domestication and adaptation of commercially important fruits, variability for economic traits, breeding strategies, clonal selection, bud mutations, mutagenesis and its application in crop improvement – ploidy manipulations – *in vitro* breeding tools (important fruit and plantation crops).

Practical

Exercises on floral biology, pollen viability; emasculation and pollination procedures; hybrid seed germination; raising and evaluation of segregating populations; use of mutagens to induce mutations and polyploidy in major crops like Mango, Banana, Citrus, Grapes, Guava, Sapota, Papaya, Custard apple, Aonla, Ber, Litchi, Pomegranate, Jamun, Arecanut, Coconut, Pistchionut, Apple, Pear, Plum, Peach, Apricot and Strawberry.

Suggested reading

Shukla A K 2004. *Fruit Breeding Approaches and Achievements*. International Book Distributing Co. New Delhi.

Ghosh S N, Verma M K. and Thakur A. 2015. *Temperate Fruit Crop Breeding: Domestication to Cultivar Development*. Narendra Publishing House, Delhi.

Kumar N. 1997. *Breeding of Horticultural Crops : Principles and Practices*. New India Publishing Agency, New Delhi.

Nijar 1985. *Fruit breeding in India*. Oxford & IBH Publishing Co. New Delhi

Ray P K. 2002. *Breeding Tropical and Subtropical Fruits*. Narosa Publishing House, New Delhi, pp. 338.

Shukla A K, Shukla A K and Vashishtha B B. 2004. *Fruit Breeding: Approaches and Achievements*. International Book Distributing Co., Lucknow (U.P), pp. 342.

Singh B D. 1983. *Plant Breeding : Principles and Methods*. Kalyani Publishers, Ludhiana, pp. 896.

FSC-222 ORCHARD AND ESTATE MANAGEMENT 1+1

Theory

Orchard &estate management, importance, objectives, merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems. Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties. Weed control factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, Integrated nutrient and pest management. Utilization of resources constraints in existing systems. Crop model and crop regulation in relation to cropping systems. Climate aberrations and mitigation measures of Horticultural crops.

Practical

Layout of different systems of orchard and estate, soil management, clean, inter, cover and mixed cropping, fillers. Use of mulch materials, organic and inorganic, moisture conservation. Calculations of weed control efficiency and weed index, Demonstration of methods of herbicide application;. Layout of various irrigation systems.

Suggested reading

Chundawat B S and Sen N L. 2002. *Principle of Fruit Culture*. Agrotech Publishing Academy, Udaipur-313002

Kumar. 1990. *Introduction to Horticulture Crops*. Rajyalakshmi Publications, Nagercoil, Tamilnadu.

Mazumdar B C. 2004. *Orchard Irrigation and Soil Management Practices* Daya Publishing Agency, New Delhi. Daya Publishing Agency, New Delhi.

Mazumdar B C. 2004. *Principles and Methods of Orchard Establishment*. Daya Publishing House, New Delhi.

Palaniappan S P and Sivaraman K. 1996. *Cropping Systems in the Tropics*. New age International (P) Ltd., Publishers, New Delhi.

Pradeep T Kumar, Suma B, Jyothi Bhaskar and Satheson K N. 2008. *Management of Horticultural Crops*. New India Publishing Agency, New Delhi.

Shanmugavelu K G. 1989. *Production Technology of Fruit Crops*. Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

VSC-222 POTATO AND TUBER CROPS **1+1**

Theory

Origin, area, production, economic importance and export potential of potato and tropical, sub-tropical and temperate tuber crops; description of varieties and hybrids. Climate and soil requirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrient and weed management; nutrient deficiencies. Use of chemicals and growth regulators; cropping systems. Harvesting practices, yield; economic of cultivation. Post- harvest handling and storage, field and seed standards, marketing. Crops to be covered – potato, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radish and other under exploited tuber crops.

Practical

Identification and description of potato and tropical, sub-tropical and temperate tuber crops; planting systems and practices; field preparation and sowing/planting. Top dressing of fertilizers and interculture and use of herbicides and growth regulators; identification of nutrient deficiencies, physiological disorders; harvest indices and maturity standards, post-harvest handling and storage, marketing. Seed collection, working out cost of cultivation, project preparation of commercial cultivation.

Suggested reading

Bose T K. 2003. *Vegetable Crops*. Naya Udyog Publishers, Kolkata. 2002. Naya Prakash, Calcutta.

Bradashaw J E. 2010. *Root and Tuber Crops*. Springer Publications.
Chadha K L. 1993.*Advances in Horticulture*. Malhotra Publishing House. New Delhi.
Choudhary B R. 2009. *A Text Book on Production Technology of Vegetables*. Kalyani Publishers. Ludhiana.
Choudhery B. 1990. *Vegetables*. 8th edition. National Book Trust, New Delhi.
Dhaliwal M S. 2008.*Handbook of Vegetable Crops*. Kalyani Publishers, Ludhiana.
Gopal Krishnan T R. 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.
Hazra P. 2006. *Vegetable Science*. Kalyani Publishers. Ludhiana.
Hazra P. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
Kamath K V. 2007.*Vegetable Crop Production*. Oxford Book Company. Jaipur.
Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi.
Sharma P. 2007. *Vegetables : Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur.
Arya P S, 1999. *Vegetable Seed Production Principles*. Kalyani Publishers, New Delhi.
Rana M K. 2008.*Olericulture in India*. Kalyani Publishers. Ludhiana.
Shanmugavelu, K.G. 1989. *Production Technology of Vegetable Crops*. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
Singh Umashankar. 2008. *Indian Vegetables*. Anmol Publications. Pvt.Ltd .New Delhi.
Thamburaj S. 2014. *Text Book of Vegetable, Tuber Crops and Spices*. ICAR, New Delhi.
Uma Shankar. 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.
Vincent Lebot. 2008.*Tropical Roots and Tuber Crops*. CAVI.
Yawalkar K S. 2004.*Vegetable Crops in India*. Agri-Horticultural Pub. House. Nagpur.

FSC-223 PLANTATION CROPS 1+1

Theory

History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by products utilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield.

Practical

Description and identification of coconut varieties, selection of coconut and arecanut mother palm and seed nut, planting of seed nuts in nursery, layout and planting of coconut, arecanut, oil

palm, cashew nut, cacao gardens, manuring, irrigation; mulching, raising masonry nursery for palm, nursery management in cacao. Description and identification of species and varieties in coffee, harvesting, grading, pulping, fermenting, washing, drying and packing of coffee, seed berry collection, seed extraction, treatment and sowing of coffee, epicotyl, softwood, grafting and top working in cashew, working out the economics and project preparation for coconut, arecanut, oil palm, cashew nut, cacao, etc. Mother plant selection, preparation of cuttings and rooting of tea under specialized structure, training, centering, pruning, tipping and harvesting of tea.

Suggested reading

Kumar N J B, Md M. Abdul Khaddar, Ranga Swamy P and Irrulappan I. 1997. *Introduction to Spices, Plantation Crops and Aromatic Plants*. Oxford & IBH, New Delhi.

Nair. 1979. *Cashew*. CPCRI, Kerala

Ranganadhan V. 1979. *Hand Book of Tea Cultivation*. UPASI Tea Research Station, Cinchona.

Thampan P K. 1981. *Hand Book of Coconut Palm*. Oxford IBH, New Delhi.

Thompson P K. 1980. *Coconut*. Oxford & IBH Publishing Co. Ltd., New Delhi.

Wood G A R. 1975. *Cacao*. Longmen, London.

NATIONAL SERVICE SCHEME/NATIONAL CADET CORPS (0+1)

Practical

NSS: Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five year plan. Functional literacy, non-formal education of rural youth, eradication of social evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition. NCC: Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush, field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self-defense, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defense, leadership and NCC song.

SEMESTER-V

NRS-311 ORGANIC FARMING 1+1

Theory

Introduction, concept, relevance in present context; Organic production requirements; Biological nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management. Weed management; Organic certification, accreditation and marketing/ exports.

Practical

Preparation of enriched compost, Vermicompost and organic amendments (Panchagavya, Jeevaamrit). Raising of vegetable crops organically and its quality analysis. Preparation of botanicals for pest and diseases control.

Suggested reading

Dahama A K. 2007. *Organic Farming for Sustainable Agriculture*. Agrobios (India), Jodhpur.

Palaniappan S P and Annadurai K. 2010. *Organic Farming – Theory and Practice*. Scientific Publishers. Jodhpur.

Purshit S S. 2006. *Trendsin Organic Farming in India*. Agros Bios (INDIA), Jodhpur.

Sharma A K. 2011. *Handbook of Organic Farming*. Agrobios (India), Jodhpur.

Thapa U and Tripathy P. 2006. *Organic Farming in India- Problems and Prospects*. Agrotech Publishing Agency, Udaipur.

Veeresh G K. 2006. *Organic Farming*. Foundation Books. New Delhi.

BTC-311 ELEMENTARY PLANT BIOTECHNOLOGY 1+1

Theory

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and *Agrobacterium* mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications: RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

Practical

Sterilization techniques, Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium, Callus induction from various explants, Regeneration of callus, Axillary bud initiation and shoot multiplication, Hardening and acclimatization, Pollen and anther culture, Protoplast isolation, Demonstration on isolation of DNA, Demonstration of gel electrophoresis techniques, DNA finger printing.

Suggested reading

Chawla H S. 2010. *Introduction to Plant Biotechnology*. Oxford & IBH Publishing Co. Pvt. Ltd.
Gupta P K. 2012. *Elements of Biotechnology*. Rastogi and Company.
Razdan M K. 1993. *An Introduction to Plant Tissue Culture*. Oxfords IBH Publishing Co. Pvt. Ltd.
Singh B D. 2003. *Biotechnology Expanding Horizons*. At Diamond Agencies Pvt. Ltd.

BSS-311 ELEMENTARY STATISTICS 2+1

Theory

Introduction to statistics, limitations of statistics. Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data, construction of frequency distribution, tables, graphic representation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quartiles, for raw and grouped data. Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poison and normal distributions, sampling, basic concepts, sampling vs. complete enumeration parameter and statistic, sampling methods, simple random sampling and stratified random sampling. Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t-tests, chi-square test for application of attributes and test for goodness of fit of Mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of simple linear regression, test of significance of correlation and regression coefficient. Experimental designs: Basic concepts, completely randomized design, randomized block design, latin square designs.

Practical

Construction of frequency distribution table and its graphical representation, histogram, frequency polygon, frequency curve, bar chart, simple, multiple, component and percentage bar charts, pie chart, mean, mode for row and grouped data, percentiles, quadrille, and median for row and grouped data, coefficient of variation, 't' test for independent, will equal and unequal variants, paired 't' test, chi-square test for contingency tables and theoretical ratios, correlation and linear regression. Design- CRD, RBD, LSD.

Suggested reading

Gupta S C and Kapoor V K. 2014. *Fundamentals of Mathematical Statistics*. Sultan chand and sons. New Delhi

Nageswara Rao G. 2007. *Statistics for Agricultural Sciences*. B S Publications, Hyderabad.

Rangaswamy R.1995. *A Text Book of Agricultural Statistics*. New Age International Publishing Limited, Hyderabad.

AGF-311 INTRODUCTORY AGRO-FORESTRY 1+1

Theory

Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Status of Indian forests and role in India farming systems. Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, horti-silvipastoral, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree crop species for agro-forestry. Agroforestry projects – national, overseas. MPTS – their management practices, economics of cultivation – nursery and planting (*Acacia catechu*, *Dalbergiasissoo*, Tectona, Populus, Morus, Grewia, Eucalyptus, Quercus spp. and bamboo, tamarind, neem etc.).

Practical

Identification and seeds and seedlings of multipurpose tree species. Nursery practices for poplar, Grewiaoptiva, Morus alba, Acacia catechu, *Dalbergiasissoo*, robinia, leucaena etc. Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral, alley cropping, horti-silviculture, agro-silvipasture, fuel and fodder blocks. Visit to social forestry plantations – railway line plantations, canal plantations, roadside plantations, industrial plantations and shelterbelts. Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages. Economics and marketing of products raised in agro-forestry systems.

Suggested reading

Chaturvedi A N and Khanna L S.1982. *Forest Menstruation*. Reprintedin2006. International Book Distributors, Dehradun

Chundawat and Gautam S K.1996. *A Text Book of Agroforestry*. Oxford and IBH Publishing company Pvt.Ltd.

Dadhwal *et al*., 2014. *Practical Manual on Agroforestry*. Jaya publishing house, Delhi.

Dwivedi A P. 1992. *Agroforestry – Principles and Practices*. Oxfird and IBH Publishing company.

Jha L K. 2015. *Advances in Agroforestry*. APH Publishing corporation, New Delhi.

Leda Satish. 2006. *Biodiesel and Jatropha Plantations*. AGROBIOS, Jodhpur.

Linford Jenny, 2007. *A Concise Guide to Trees*. Parragon books service limited, Parragon.

Luna R K.1989. *Plantation Forestry in India*. International Book Distributors, Dehradun.

Negi S S. 2006. *Forest Tree Seed*. Prashant Gahlotat Valley printers and publishers, Dehradun.
Negi S S. 2007. *Agroforestry Hand Book*. International book distributer, New Delhi.
Panwar P and Puri S. 2007. *Agroforestry: Systems & Practices*. New India Publishing Agency, New Delhi.
Pathak P S and Ram Newaj. 2010. *Agroforestry – Potentials and Opportunities*. Agrobios, Jodhpur
Patra A K. 2013. *Agroforestry – Principles and Practices*. New India publishing agency.
Ramachandran and Nair P K.1993. *An Introduction to Agroforestry*. First reprint inIndia–2008. Springer International Edition
Umrani R and Jain C K. 2010. *Agroforestry – Systems & Practices*. ABD Publishers, New Delhi.
Tejawani K G. 1994. *Agroforestry in India*. Oxford & IBH, Publishing Co.Pvt.Ltd.,New Delhi

PPP-311 Diseases of Vegetable, Ornamentals and Spice Crops 2+1

Theory

Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases of the following vegetables, ornamental and spice crops: tomato (damping off, early blight, buckeye rot, bacterial wilt, bacterial canker, leaf curl, and tomato mosaic), brinjal (Phompsis blight, Cercospora leaf spot, bacterial wilt and little leaf), chilli (Phytophthora leaf blight and fruit rot, anthracnose and ripe rot, bacterial leaf spot, leaf curl and mosaic), bhindi (Fusarium wilt, Cercospora leaf spot, powdery mildew and yellow vein mosaic), cabbage (downy mildew, stalk rot, Alternaria leaf spot and black rot), cauliflower and knolkhol (downy mildew, stalk rot, black rot, cauliflower mosaic), radish (Alternaria blight, white rust and downy mildew), pea(powdery mildew, Ascochyta blight, Fusarium wilt, bacterial blight and mosaic), beans (root rot and web blight, anthracnose, angular leaf spot, common blight and mosaic) beet root (Cercospora leaf spot, powdery mildew and Sclerotium root rot), onion (downy mildew, purple blotch and Fusarium basal rot), garlic (Stemphylium blight and Fusarium basal rot), fenugreek (powdery mildew, Alternaria blight and root rot), ginger (Rhizome rot, Phyllosticta leaf spot, bacterial wilt), potato (late blight, early blight, black scurf, brown rot and potato leaf roll), turmeric (rhizome rot, Taphrina leaf blotch and leaf spot), pepper (Phytopthora foot rot and wilt), cumin (wilt, blight and powdery mildew), small cardamom (capsule rot,rhizome rot andkatte disease),large cardamom(leaf streak, anthracnose), nutmeg (chirkeyfurkey disease, leaf spot and shot hole, thread blight), coriander (wilt, stem gall and powdery mildew), clove (leaf spot, twig blight and flower shedding, little leaf), cinnamon (leaf spot and die back, canker), jasmine (leaf blight, leaf spot, rust and wilt), rose (powdery mildew, black spot, grey mould), crossandra (wilt, Botrytis spot and blight and Sclerotium wilt), tuberose (crown and stem rot), geranium (Botrytis spot and blight, Pythium black leg). Important post-harvest diseases of vegetables and ornamental crops and their management.

Practical

Observations of symptoms, causal organisms and host parasitic relationship of important diseases, examination of cultures of important pathogens of vegetables, ornamental and spice crops.

Suggested reading

Agrios G N. 2005. *Plant Pathology*. 5th Ed., Elsevier Academic Press, Amsterdam. 922p.

Chandel S and Sharma R C. 2011. *Diagnosis and Management of Floral Crops Diseases-A Practical Guide*. LAP Lambert Academic Publishers, Germany, 80p.

Gupta S K and Thind T S. 2006. *Disease Problem in Vegetable Production*. Scientific Publishers., Jodhpur, 576p.

Gupta V K and Paul Y S. 2001. *Diseases of Vegetable Crops*. Kalyani Publishers. New Delhi, 344p.

Singh R S. 1995. *Diseases of Vegetable Crops*, 3rd Ed., Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 406p.

Sohi H S. 1992. Diseases of Ornamental Plants in India. ICAR, New Delhi, 195p.

EXT-311 FUNDAMENTALS OF EXTENSION EDUCATION 1+1

Theory

Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Horticulture extension: process, principles and selected programmes of leading national and international forest institutes. People's participation in Horticulture programmes. Motivation of Farmers, rural youth and voluntary organizations for Horticulture extension work Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) etc. of ICAR. Communication: meaning, definition, elements and selected models. Audio – visual aids: importance, classification and selection. Adoption and diffusion process, Teaching and learning-concepts and principles, Teaching steps, Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA). Management and administration: meaning, definition, principles and functions. Concepts of human resource development (HRD), rural leadership. ICT in Extension education, ICT use in rural India.

Practical

Visits to study structure, functions, linkages and extension programmes of ICFRE institutes/voluntary organizations/Mahila Mandal, Village Panchayat, State Dept. of Horticulture /All India Radio (AIR). Exercises on distortion of message, script writing for farm broadcasts and telecasts, planning, preparation & use of NPVA like poster, chart, flash cards, folders etc.

and AVA like OHP & 35 mm slide projector transparencies. Identification of local leaders to study their role in extension work. Evaluation of some selected case studies of forestry extension programmes. Preparation of Village Agricultural productions plan.

Suggested reading

Reddy A A. 2001. *Extension Education*, Sree Lakshmi press, Bapatla.

Dahama O P and Bhatnagar O P. 1998. *Education and Communication for Development*, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

Hilaris M. 2011. *Indian agriculture and information:* Soundari, New century Publications, and communication technology (ICT).

Jalihal K A and Veerabhadraiah V. 2007. *Fundamentals of Extension Education and Management in Extension*, Concept Publishing Company, New Delhi.

Muthaiah M P and Arunachalam R. *Agricultural Extension*, Himalaya Publishing House (Mumbai).

Rathore O S *et al.*, 2012. *Handbook of Extension Education*, Agrotech Publishing Academy, Udaipur.

Ray G L. 1991. *Extension Communication and Management* (1st Edition), Kalyani Publishers, Ludhiana (7th revised edition – 2010).

Sagar M and Ray G L. *Text Book on Rural Development, Entrepreneurship and Communication Skills*, Kalyani Publications.

Supe S V. 2013. *A Text Book of Extension Education* (2nd Edition), Agrotech Publishing Academy, Udaipur.

Van D B A W and Hawkins H S. *Agricultural Extension*. CBS Publishers & Distributors, New Delhi.

PHT-311 Postharvest Management of Horticultural Crops 2+1

Theory

Importance of postharvest technology in horticultural crops. Maturity indices, harvesting, handling and grading of fruits, vegetables, cut flowers, plantation crops, spices, medicinal and aromatic plants. Pre-harvest factors affecting postharvest quality. Factors responsible for deterioration of horticultural produce, physiological and bio-chemical changes and delaying ripening process. Quality parameters and standards. Structure and composition of fruits, vegetables and cut flowers. Pre- and post-harvest treatments. Storage considerations, traditional and modern storage systems, Storage disorders of important horticultural crops. Packaging materials, types of containers, packaging methods and internal packaging material. Marketing methods. Modes of transport for domestic and export marketing.

Practical

Study of seasonal availability of horticultural crops, practice in judging the maturity of various horticultural produce, determination of quality parameters: physical, biochemical and sensory characteristics, grading of horticultural produce, post-harvest treatments for horticultural crops, identification of packaging materials, packaging of fruits, vegetables, plantation crops, spices and cut flowers by using different packaging materials, storage methods and identification of storage disorders in horticultural crops. Visits to markets, packing houses and cold storage units.

Suggested reading

Battacharjee S K and De L C. 2005. *Post Harvest Technology of Flowers and Ornamentals Plants*. Pointer Publisher, Jaipur, India.

Chadha K L and Kalloo G. 1993. *Advances in Horticulture*. Vol. 4 to 10. MPH, New Delhi.

Kader A A, Kasmire R F, Mitchell F G, Reid MS, Sommer N F and Thompson J F. 2002. *Post-harvest Technology of Horticultural Crops*. University of California, Agriculture and Natural Resources Publication No 3529.

Mitra S K. 1997. *Postharvest Physiology and Storage of Tropical and Sub-tropical Fruits*. CAB International.

Pruthi J S. 2001. *Minor Spices and Condiments – Crop Managements and Post Harvest Technology*. ICAR, New Delhi.

Ryall A L, Lipton W J and Pentzer W T. 1972. *Handling, Transportation, and Storage of Fruits and Vegetables: Fruits and Tree Nuts*. AVI Publishing Company.

Ryall L and Lipton W J. 1982. *Handling, Transportation and Storage of Fruits and Vegetables*: Vol. 1 & 2. AVI Publishing Company.

Saraswathy S, 2008. *Postharvest Management of Horticultural Crops*. Agribios Publications.

Shanmugavelu K G, Kumar N and Peter K V. 2002. *Production Technology of Spices and Plantation Crops*. Agrobios (India).

Stanley J K. 1998. *Postharvest Physiology of Perishable Plant Products*. CBS, New Delhi.

Thompson A K. 1996. *Postharvest Technology of Fruits and Vegetables*. Wiley-Blackwell.

Wills R B H, McGlasson W B, Graham D and Joyce D C. 2007. *Postharvest- An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals*. CAB International.

VSC-311 BREEDING OF VEGETABLE, TUBER AND SPICE CROPS 2+1

Theory

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops. Plant genetic resources, their conservation and utilization in crop improvement. Breeding for insect resistance, breeding for disease resistance, breeding for abiotic resistance, male sterility and incompatibility and their utilization in development of hybrids. Origin, distribution of species, wild relatives and forms of vegetable crops Tomato, Brinjal, Bhendi, Capsicum, Chilli, Cucurbits, Cabbage, Cauliflower. Tuber crops, Potato,

Carrot, Radish, Spice crops (Ginger, Turmeric).Breeding procedures for development of hybrids/varieties in various crops. Genetic basis of adoptability and stability.

Practical

Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber crops and spices. Working out phenotypic and genotypic heritability, genetic advance. GCA, SCA, combining ability, heterosis, heterobeltosis, standard heterosis, GxE interactions (stability analysis) Preparation and uses of chemical and physical mutagens. Polyploidy breeding and chromosomal studies. Techniques of F1 hybrid seed production. Maintenance of breeding records.

Suggested reading

Dhaliwal M S. 2009. *Vegetable Seed Production & Hybrid Technology*. Kalyani Publishers. Ludhiana.

Dhaliwal M S. 2012. *Techniques of Developing Hybrids in Vegetable Crops*. Agrobios. Jodhpur.

Fageria M S. 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani Publishers, Ludhiana.

Hari Hara Ram. 2013.*Vegetable Breeding: Principle and Practices*. Kalyani Publishers. Ludhiana.

Kallo G. 1998. *Vegetable Breeding (Vol.I to IV)*. CRC Press. Florida. 1988.

Singh H P. 2009.*Vegetable Varieties of India*. Studium Press (India) Pvt Ltd. New Delhi.

Singh P K. 2005. *Hybrid Vegetable Development*. CRC Press. Florida.

Vishnu Swaroop. 2014. *Vegetable Science &Technology in India*. Kalyani Publishers. Ludhiana.

VSC-312 PRECISION FARMING AND PROTECTED CULTIVATION 2+1

Theory

Precision farming – laser leveling, mechanized direct seed sowing; seedling and sapling transplanting, mapping of soils and plant attributes, site specific input application, weed management, insect pests and disease management, yield mapping in horticultural crops. Green house technology, Introduction, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, Typical applications, passive solar green house, hot air greenhouse heating systems, green house drying. Cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required,

drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT) / hydroponics.

Practical

Study of different types of greenhouses based on shape, construction and cladding materials; Calculation of air rate exchange in an active summer winter cooling system; Calculation of rate of air exchange in an active winter cooling system; Estimation of drying rate of agricultural products inside green house; Testing of soil and water to study its suitability for growing crops in greenhouses; The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution; The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization; Visit to commercial green houses; Economics of protected cultivation.

Suggested reading

Aldrich R A and Bartok J W. 1994. *Green House Engineering*. NRAES, Riley, Robb Hall. Cornell University, Ithaca, New York.

Balraj Singh. 2006. *Protected Cultivation of Vegetable Crops*. Kalyani Publishers, Ludhiana.

Brahma Singh, 2014. *Advances in Protected Cultivation*. New India Publishing Agency, New Delhi.

Singh J, Jain S K, Dashora L K, Cundawat B S. 2013. *Precision Forming in Horticulture*. New India Publishing Agency, New Delhi.

Jitendra Singh. 2015. *Precision Farming in Horticulture*. New India Publishing Agency, New Delhi.

Pant V Nelson. 1991. *Green House Operation and Management*. Bali Publication.

Kumar P T, Suma B, Bhaskar J and Satheson K N. 2008. *Management of Horticultural Crops*. New India Publishing Agency, New Delhi.

Prasad S. 2005. *Greenhouse Management for Horticultural Crops*. Agrobios. Jodhpur.

Reddy P Parvatha. 2003. *Protected Cultivation*. Springer Publications. USA.

Reddy P Parvatha. 2011. *Sustainable Crop Protection under Protected Cultivation*. Springer Publications. USA.

SEMESTER-VI

PPE-321 APICULTURE, SERICULTURE AND LAC CULTURE 1+1

Theory

Introduction to beneficial insects. Importance and History of apiculture. Species of honey bees. Rock bee, Little bee, Indian bee, European bee, Italian bee and Dammar bee, lifecycle and caste determination. Bee colony maintenance, bee colony activities, starting of new colony, location site, transferring colony, replacement of queen, combining colonies, swarm prevention, colony

management in different seasons, Beekeeping equipments and their description. Bee pasturage. Extraction, composition and uses of Honey. Other bee products. Role of honeybees in pollination. Diseases and enemies of honeybees and their management. Importance, History and development of sericulture in India, silkworms kinds and their hosts, systematic position, distribution, Silk glands. Mulberry silkworm-life cycle in brief, rearing house and equipments, disinfection and hygiene. Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs. Silkworm rearing young age/chawki rearing and old age rearing of silkworms. Feeding, spacing, environmental conditions and sanitation. Cocoon characters colour, shape, hardiness and shell ratio. Defective cocoons and stifling of cocoons. Uses of silk and by-products. Economics of silk production. Moriculture-Mulberry varieties, Pests and diseases of silk worms and their management. Lac growing areas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac-insects.

Practical

Familiarization with different species and castes of honey bees. Familiarization with bee hives and other beekeeping equipments. Study of external morphology of honeybees. Handling of Honey bee colony. Inspection and maintenance of apiary records. Collection and preservation of bee pasture. Seasonal Management of Honey bee colonies. Study of enemies of honeybees and their control Study of diseases of honey bees and their management. Queen rearing. Study of expenditure involved and income generation from commercial and stationary bee keeping. Visit to State Sericulture unit.

Suggested reading

Ganga G and Sulochana C J. 1997. *An Introduction to Sericulture* (2nd Ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Mishra R C. 2002. *Perspectives in Indian Apiculture*. Agrobios, Jodhpur. India.

Pradip V J. 2005. *Text Book of Applied Zoology : Vermiculture, Apiculture, Sericulture, Lac-Culture, Agricultural Pests*. Discovery, New Delhi. 494p

Singh S. 1975. *Bee Keeping in India*-ICAR, New Delhi. 214p.

PHT-321 PROCESSING OF HORTICULTURAL CROPS 1+2

Theory

Importance and scope of fruit and vegetable preservation industry in India, food pipe line, losses in post-harvest operations, unit operations in food processing. Principles and guidelines for the establishment of processing units. Principles and methods of preservation by heat - pasteurization, canning, bottling. Methods of preparation of juices, squashes, syrups, cordials and fermented beverages. Methods of preparation of Jam, jelly and marmalade. Preservation by sugar- candies, crystallized fruits, preserve etc. Preservation by chemical preservatives, preservation with salt and vinegar- pickling, chutneys and sauces, tomato and mushrooms products. Drying and dehydration, freezing preservation. Processing of plantation crops,

spoilage in processed foods, quality control of processed products, Govt. policy on import and export of processed fruits. Food laws.

Practical

Equipments used in food processing units. Physico-chemical analysis of fruits and vegetables. Canning of fruits and vegetables, preparation of squash, RTS, cordial, syrup, jam, jelly, marmalade, candies, preserves, chutneys, sauces, pickles (hot and sweet). Dehydration and low temperature preservation of fruits and vegetables, tomato products and quality analysis of processed foods. Visit to processing units.

Suggested reading

Fellows P J. 1998. *Food Processing Technology – Principles and Practices*. Ellis Horwood.

Manoranjan K and Sangita S. 1996. *Food Preservation & Processing*. Kalyani Publishers, India.

Potter N N and Hotchkiss J H. *Food Science*. 5th Edition. CBS Publishers. New Delhi.

Salunkhe D K, Bolin H R and Reddy N R. 1991. *Storage, Processing and Nutritional Quality of Fruits and Vegetables*. 2nd Edition. Vol. II. CRC Press.

Siddappaa G S, Lal G and Tandon G L. 1998. *Preservation of Fruits and Vegetables*. ICAR. New Delhi.

VSC-321 Seed Production of Vegetable, Tuber and Spice Crops 2+1

Theory

Introduction and history of seed industry in India. Definition of seed, classes-types of seed. Differences between grain and seed. Importance and scope of vegetable seed production in India. Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of cole crops, root vegetables, solanaceous vegetables, cucurbits, okra, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. Seed germination and purity analysis. Field and seed standards. Seed drying and extraction. Seed legislation.

Practical

Study of seed structure, colour size, shape and texture. Field inspection of seed crops. Practices in rouging. Harvesting and seed extraction. Germination and purity analysis. Methods of seed production, Seed certification in cole crops, root vegetables, bulb crops, solanaceous vegetables, cucurbits, okra, leafy vegetables, leguminous vegetables and exotic vegetables. Seed processing machines. Visit to seed production units.

Suggested reading

Agarwal P K. 2010. *Techniques in Seed Science and Technology*. South Asian Publishers. New Delhi.

Agarwal R L. 1995. *Seed Technology*. Oxford & IBH, New Delhi.
Agrawal R. L. 1999. *Seed Technology*. Oxford and IBH Publicity Company, New Delhi.
Arya P S. 2003. *Vegetable Breeding, Production and Seed Production*. Kalyani Publishers, New Delhi.
Arya P S. 2003. *Vegetable Seed Production Principles*. Kalyani Publishers. Ludhiana.
Copeland L O. 1999. *Principles of Seed Science and Technology*. Springer Publications.
Fageria M S. 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani Publishers. Ludhiana.
Geetharani P. 2007. *Seed Technology in Horticultural Crops*. NPH Publications. Jodhpur.
Hazra P and Som M G. 2009. *Vegetable Seed Production and Hybrid Technology*. Kalyani Publishers. Ludhiana.
Khare D and Bhole M S. 2000. *Seed Technology*. Scientific Publishers (India) Jodhpur.
Kulkarni G N. 2002. *Principles of Seed Technology*. Kalyani Publishers, Ludhiana.
Nema N P. 1988. *Principles of Seed Certification and Testing*. Allied Publications.
Singh N, Singh P K, Singh Y K and Kumar V. 2006. *Vegetable Seed Production Technology*. International book distributing co., Lucknow.
Raymond A T. 2000. *Vegetable Seed Production*. Oxford University Press, USA
Singh Prabhakar. 2015. *Seed Production Technology of Vegetable*. Daya Publishing House. New Delhi.
Singh S P. 2001. *Seed Production of Commercial Vegetables* (1st Ed). Agrotech Publishing, Udaipur
Vanangamudi K. 2010. *Vegetable Hybrid Seed Production and Management*. Agrobios. Jodhpur.

FLA-321 Breeding and Seed Production of Flower and Ornamental Crops 2+1

Theory

History of improvements of ornamental plants. Centre of origin of flower crops and ornamental crops, objectives and techniques in ornamental plant breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops viz. Rose, Jasmine, Chrysanthemum, Tuberose, Gerbera, Gladiolus, Dahlia, Heliconia, Lilium, Gaillardia, Petunia, Hibiscus, Bougainvillea, Zinnia, Cosmos, Dianthus, Snapdragon, Pansy, Crossandra, Marigold, Geranium, China aster, Orchids, Anthurium, Carnation etc. Breeding for disease resistance. Development of promising cultivars of important ornamentals and flower crops. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting, processing and storage, seed certification.

Practical

Study of floral biology and pollination in important species and cultivars. Techniques of hybridization, inducing polyploidy and mutation. Production of pure and hybrid seeds. Harvesting, conditioning and testing of seeds. Practice in seed production methods.

Suggested reading

Agarwal P K. 1994. *Principles of Seed Technology*. ICAR Publication, New Delhi.

Agarwal R L. 1996. *Seed Technology*. Oxford & IBH Publishers, New Delhi.

Bhattacharjee S K and De L C. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers. Distributors, Jaipur (Rajasthan) India.

Bose T K, Yadav L P, Patil P, Das P and Partha Sarthy V A. 2003. *Commercial Flowers*. Partha Sankar Basu, Naya Udyog, 206, Bidhan Sarani, Kolkata.

Callaway D J and Callaway M B. 2000. *Breeding Ornamental Plants*. Timber Press. USA.

De L C and Bhattacharjee S K. 2011. *Ornamental Crop Breeding*. Aavishkar Publishers Distributers, Jaipur.

Harding J, Singh F and Mol J N. 1991. *Genetics and Breeding of Ornamental Species*. Springer Publishers.

Pal B P. 1966. *The Rose in India*. Directorate of Knowledge Management in Agriculture. ICAR. New Delhi.

Singh A K. 2014. *Breeding and Biotechnology of Flowers*. Vol. I & II. Commercial Flowers. Garden Flowers. New India Publishing Agency, New Delhi.

Singh B D. 1983. *Plant Breeding* : Principles and Methods. Kalyani Publishers, New Delhi.

Vainstein A. 2002. *Breeding for Ornamentals* : Classical and Molecular Approaches. Springer Publishers.

FPR-321 MEDICINAL AND AROMATIC CROPS **2+1**

Theory

Introduction to medicinal and aromatic plants & their role in Indian economy. Importance, origin, distribution, area, production, phytochemical constituents, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements, plant protection, harvesting and processing of under mentioned important medicinal and aromatic plants.

Medicinal Plants: *Withania*, Periwinkle, Rauvolfia, Isabgol, *Betelvine*, *Kalmegh*, *Senna* Opium poppy. Introduction to important medicinal plants of Himalayan region like Chirayata, kutki, Podophyllum Aconitum, Indian Valerian etc.

Aromatic Plants: Lemon grass, Citronella, Palmarosa, Khus grass, lavender, Geranium, Mint, Ambrette, Basil and Tagetes.

Essential oils, Extraction, quality evaluation & Storage techniques of essential oils. Concept of GAP in medicinal and aromatic plants production.

Practical

Identification of medicinal and aromatic plants& their economic parts, Raw drugs, propagation techniques – Harvesting and oil extraction of aromatic plants – Field visit, collection and preparation of herbarium – Visiting commercial units of medicinal plants.

Suggested reading

Atal C K and Kapur B M. 1982. *Cultivation and Utilization of Aromatic Plants*. Regional Research Laboratory Jammu-Tawi, CSIR, New Delhi.

Atal C K and Kapur B M. 1982. *Cultivation and Utilization of Medicinal Plants*. Regional Research Laboratory Jammu-Tawi, CSIR, New Delhi.

Chadha K L and Gupta R. 1995. *Advances in Horticulture. Vol 11: Medicinal and Aromatic Plants*. Malhotra Publishing House, New Delhi.

Akhtar H, Viramani O P, Sharma A, Kumar A and Misra L N. 1998. *Major Essential Oil Bearing Plants of India*. CIMAP, Lucknow, India.

Akhtar Hussain. 1993. *Medicinal Plants and Their Cultivation*. CIMAP, Lucknow, India.

ICT-321 INFORMATION AND COMMUNICATION TECHNOLOGY 1+1

Theory

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of AV aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.

Practical

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

Suggested reading

Harshawardhan P Bal. 2003. *Perl Programming for Bioinformatics*. Tata McGraw-Hill Education.

Kumar A. 2015. *Computer Basics with Office Automation*. IK International Publishing House Pvt Ltd.

Rajaraman V and Adabala N. 2015. *Fundamentals of Computers*. PHI.

Singh G, Singh R and Saluja K K. 2003. *Fundamentals of Computer Programming and Information Technology*. Kalyani Publishers.

BMH-321 HORTI-BUSINESS MANAGEMENT 2+0

Theory

Farm management - definition, nature, characteristics and scope. Farm management principles and decision making, production function, technical relationships, cost concepts, curves and functions – factors, product, relationship – factors relationship, product relationship, optimum conditions, principles of opportunity cost-equi-marginal returns and comparative advantages, time value of money, economic of scale, returns to scale, cost of cultivation and production, break even analysis, decision making under risk and uncertainty. Farming systems and types. Planning – meaning, steps and methods of planning, types of plan, characteristics of effective plans. Organizations – forms of business organizations, organizational principles, division of labour. Unity of command, scalar pattern, job design, span of control responsibility, power authority and accountability. Direction – guiding, leading, motivating, supervising, coordination – meaning, types and methods of controlling – evaluation, control systems and devices. Budgeting as a tool for planning and control. Record keeping as a tool of control. Functional areas of management – operations management – physical facilities, implementing the plan, scheduling the work, controlling production in terms of quantity and quality. Materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ). Personnel management – recruitment, selection and training, job specialization. Marketing management – definitions, planning the marketing programmes, marketing mix and four P's. Financial management – financial statements and rations, capital budgeting. Project management – project preparation evaluation measures.

Suggested reading

Chandra P. 2014. *Projects – Planning , Analysis , Selection , Financing, Implementation and Review* 8th Edition McGraw Hill Education (India) Private Limited.

Gittiner J P.1982. *Economic Analysis of Agricultural Projects*. The John Hopkins University Press Baltimore, USA.

Harold Koontz. 2004. *Principles of Management*. Tata McGraw-Hill Education Private Limited. New Delhi.

Jain S P. 2014. *Financial Accounting*. Kalyani Publications, Ludhiana.

Johl S S and Kapur J R. 2006. *Fundamentals of Farm Business Management*. Kalyani Publishers, New Delhi.

Pandey U K 1990. *An Introduction to Agricultural Finance* .Kalyani Publishers, New Delhi.

Prasad L. M. 2001. *Principles and Practices of Management*, 9th Ed. S. Chand & Sons, New Delhi.

Singh K and Kahlon A S. 1992. *Economics of Farm Management in India: Theory and Practice*. New Delhi.

Subba Rao P. 2009. *Human Resource Management*. Himalaya Publications., New Delhi.

Thomas P C. 2008. *Managerial Economics*, 9th Ed. Kalyani Publishers., New Delhi.

BMH-322 Entrepreneurship Development and Business Management 1+1

Theory

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis. Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Supply chain management and total quality management. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business. Communication Skills: meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills developing organizational and managerial skills, problem solving skills, field diary and lab record; indexing, footnote and bibliographic procedures.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; Conducting market survey to the demand for product, preparing advertisements for popularization of product, news writing, preparing project proposals, individual, group presentation, features of oral presentation, presentation, evaluation of presentation and evaluation of sheet, dyadic communication-face to face conversation, telephone conversation, rate of speech and clarity of voice, speaking and listening politeness, telephone etiquettes, organising general and group meeting, salient features of participation in seminars and conferences, conducting and participating in mock interviews.

Suggested reading

Chole R R, *et al.* 2012. *Entrepreneurship Development and Communication Skills*. Scientific Publishers, Jodhpur.
Singh A K. 2009.*Entrepreneurship Development and Management*. Lakshmi Publications Ltd., New Delhi.
Gittiner J P. 1982. *Economic Analysis of Agricultural Projects*. The John Hopkins University Press Baltimore, USA.
Hopkins J A and Baker C B D. 2011. *Financial Management in Agriculture*. 7th Ed. Barry P J. IL Interstate Publishers, USA.
Kotler P and Armstrong. 2013. *Principles of Marketing*. Prentice-Hall. 15th Edition, PHI, New Delhi.
Pandey U K. 1990. *An Introduction to Agricultural Finance*. Kalyani Publishers: New Delhi.
Kumar A S, Poornima S C, Abhraham M K and Jayashree K 2008.*Entrepreneurship Development*. Newage International Publishers, New Delhi.
Mondal S and Ray G L. 2011.*Text Book on Rural Development, Entrepreneurship and Communication Skills*. Kalyani Publishers, New Delhi.
Somani L L. 2009. *Extension Education and Communication*. Agrotech. Publishing Academy. Udaipur.

PPE-322 Insect Pests of Vegetable, Ornamental and Spice Crops 2+1

Theory

Economic importance of insects in vegetable, ornamental and spice crops -ecology and pest management with reference to these crops. Pest surveillance in important vegetable, ornamental and spice crops. Distribution, host range, bio-ecology, injury, integrated management of important insect-pests affecting vegetable, ornamental and spice crops. Important storage insect-pests of vegetable, ornamental and spice crops, their host range, bio-ecology, injury and integrated management. Insect –pests of processed vegetables and ornamental crops, their host range, bio-ecology, injury and integrated management. Insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc. Pesticides application equipments.

Practical

Study of symptoms, damage, collection, identification, preservation, assessment of damage/population of important insect-pests affecting vegetable, ornamental and spice crops in field and during storage. Use of pesticide application equipments.

Suggested reading

Atwal A S and Dhaliwal G S. 2015. *Agricultural Pests of South Asia*. Kalyani Publishers, Ludhiana.
Chandel R S, Mehta P K, Sharma P C and Pathania M. 2016. *Insect Pests of Vegetable Crops*. Kalyani publishers, New Delhi.

Dhaliwal G S and Arora R. 2006. *Integrated Pest Management: Concept and Approaches*. 2nd revised edition Kalyani Publishers, New Delhi.

Sathe T V. 2012. *Pests of Ornamental Plants*. Daya Publishers. New Delhi.

STUDENT READY-EXPERIENTIAL LEARNING PROGRAMME/ ELP+RHWE (0+40)

Practical

Students will practically gain hands on expertise for a semester in any two options out of commercial horticulture, protective cultivation of high value horticulture crops, processing of fruits and vegetables for value addition, floriculture and landscape gardening, mushroom cultivation and bee keeping. In one semester, students will be working with horticulture farmers/horticulture based industries in collaboration with developmental departments, extension functionaries, input suppliers, marketing and procurement functionaries, processing industries and will be attached with Research Stations and KVKs.

SEMESTER-VII

EXPERIENTIAL LEARNING PROGRAMME **0+20**

ELH-411 Module-I. Commercial Horticulture (Fruits): Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, plant certification, packaging and marketing, quality control.

ELH-412 Module-II. Protective Cultivation of High Value Horticulture Crops (Vegetables): Visit to commercial polyhouses. Project preparation and planning. Specialised lectures by commercial export house. Study of designs of green- house structures for cultivation of crops. Land preparation and soil treatment. Planting and production: Visit to export houses; Market intelligence; Marketing of produce; cost analysis; Visit to export houses; Market intelligence; Marketing of produce; cost analysis; institutional management. Report writing and viva-voce.

ELH-413 Module-III. Processing of Fruits and Vegetables for Value Addition: Planning and execution of a market survey, preparation of processing schedule, preparation of project module based on market information, calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects, identification of sources for procurement of raw material, production and quality analysis of fruits and vegetables products at commercial scale, packaging, labelling, pricing and marketing of product.

ELH-414 Module-IV. Floriculture and Landscape Gardening: Preparation of project report, soil and water analysis, preparation of land and layout. Production and Management of commercial flowers. Harvesting and postharvest handling of produce. Marketing of produce, Cost Analysis, Institutional Management. Visit to Flower growing areas and Export House. Attachment with private landscape agencies. Planning and designing, site analysis, selection and use of plant material for landscaping. Formal and informal garden, features, styles, principles and elements of landscaping. Preparation of

landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues. Making of lawns, use of software in landscape. Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces. Dry flower Technology (identification of suitable species, drying packaging and forwarding techniques).

ELH-415 Module-V. Mushroom Cultivation : Construction cultivation room/structure and Disinfection. Compost preparation & pasteurization. Procurement of mother culture and spawn preparation. Procurement of casing soil and preparation for production. Mushroom seeding. Casing with soil and maintenance. Harvesting, processing, Grading, packing, marketing and Cost economics of mushroom culture.

ELH-416 Module-VI. Bee Keeping: Procurement and arrangement of bee keeping equipments. Location and collection of potent nectar yielding bee flora seeds from wild. Raising/enriching the rich nectar yielding bee flora in the campus. Location and hiving the natural bee colony from the wild. Establishing the apiary with suitable/favourable necessaries. Maintenance and multiplication of hive colonies. Management of natural enemies and diseases of bees. Maintenance of bee colonies during dearth and honey flow seasons. Harvesting and Processing of honey and bee wax. Marketing and cost analysis.

SEMESTER-VIII

RURAL HORTICULTURAL WORK EXPERIENCE PROGRAMME 0+20

RHW-421	Rural Horticultural Works Experience	0+10
RHW-422	Attachment with Research Stations / KVK's	0+10

i. **STUDENT READY - Placement in Villages (0+10)**

ii. **STUDENT READY- Placement in Industries (0+10)**

S. No.	RHWE Programme Schedule	Duration
1	Orientation Programme	2 weeks
2	Village stay at Research Stations / KVKs	12 weeks
3	All India Study Tour	3 weeks
4	Placement Programme	4 weeks
5	Report Writing & Final Examination	3 weeks
	Total	**24 weeks**

What Advantages, SKUAST-J has?

The Faculty of Agriculture of SKUAST-J at Main Campus is having three Divisions namely: The Division of Fruit Science, Division of Vegetable Science & Floriculture and Division of PHT/Food Science & Technology of SKUAST-Jammu. Till date, the Divisions are associated with research, extension education and under-graduate/Post-graduate teaching. The major activities of these Divisions is to conduct research, to improve production, productivity and quality of different fruit, vegetable and flower crops and to develop efficient post harvest technologies for different horticultural produce. The manpower available in these three Divisions will be judiciously utilized for training to horticulture graduates. Following posts are existing in these three divisions:

Division	Prof.	Assoc. Prof.	Asstt. Prof.	Computer Assistant	STA	Jr. Steno/ Steno.	FCLA	Mali/ Gardner/ OCC/ Helper
Fruit Science	2	1	5	-	-	1	3	7
Food Science & Technology	-	1	4	1	1	-	2	1
Vegetable Science & Floriculture	1	3	5	1	-	1	4	7

Additional Faculty Requirements

S. No.	Name of Division	Asstt. Prof.
1.	Fruit Science (Breeding + Production)	2
2.	Vegetable Science (Breeding + Production) + Seed Production/Seed Technology	2
3.	Floriculture and Landscape Architecture (Breeding + Production)	1
4.	Post Harvest Technology	1
5.	Plant Protection (Entomology + Plant Pathology + Nematology)	2
6.	Basic Sciences (Biochemistry, Crop Physiology, Biotechnology & Genetics, and Plant Breeding, Statistics, Computer Science)	1
7.	Natural Resource Management (Soil Science & Ag. Chemistry, Microbiology, Water Technology Centre, Environmental Sciences, Agricultural Engineering, Agro-forestry)	1
8.	Social Science (Agriculture Extension, Agriculture Economics, Agri./Horticulture Business Management, English, Physical Education, Library Science)	1
	Total	11

Administrative/Technical Requirements for the Faculty of Horticulture.

S. No.	Position	Number
a)	Jr. Stenographer	01
b)	Accounts Assistant	01
c)	FCLA	05
d)	Tractor Driver	01
e)	Mali/Gardner	06
f)	Office Attendant	02
Total		**16**

Infrastructure

The basic infrastructure required for running the proposed under-gra programme includes building to house departments, offices, class rooms, labo room and hostel. The SKUAST-J has three building floors which are housing th viz., Fruit Science, Food Science & Technology and Vegetable Science and Faculty of Agriculture, Chatha, which can be used for commencing the programme. Division of Fruit Science also has tissue culture lab. facility as laboratory. The Division of Food Science & Technology has a FPO registered FoA, Chatha and can be utilized for imparting training on post-harvest horticulture crops. The orchards being established under Centre of Excellence having almost all the commercial cultivars of sub-tropical fruit crops at FoA Udh area of more than 5.0 hectares of land which can be used for conducting students research. Besides, a well equipped Quality Control Laboratory (QCL) facilities are at FoA, Chatha which can also be utilized for imparting trainings to under-gradu

Outcome

Successful institutionalization and effective implementation of B.Sc.(Hort) degr expected to develop the manpower for meeting the growing demands of this sec the acquired skills in the expanded scenario of developments in horticultu technology will witness the introduction of hi-tech measures like micro irrig cultivation, micropropagation etc. Moreover, in the scenario of limited availabi resources like land and water, the focus would be on precision farming for deri returns per unit of area.

State-of-the-art in education in horticulture and allied sciences will equip students life, which is rewarding in all senses. It is expected to undertake basic and scie gain insights in complex mechanisms that will lead to the evolution of new enhanced horticultural production, and preservation of environmental quality. It will also training and consultancy to farmers, entrepreneurs, and departmental functionari