

## II Year IV Semester

### AGR 203 Agronomy of Field Crops – I 1+1

#### Theory

##### Unit I: Cereals

Cereals: Rice, Maize, Wheat, Oat, Barley, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield.

##### Unit II: Millets

Millets: Sorghum, Pearl millet, Finger millet, Small millets, Foxtail millet, little millet, Kodo millet and common millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

##### Unit III: Pulses

Pulses: Red gram, Black gram, Green gram, Bengal gram, Horse gram, Cowpea, Soybean and Lentil - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

##### Unit IV: Oil Seeds I

Oil seeds: Ground nut, sesame, sunflower, castor and soybean - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

##### Unit V: Oil Seeds II

Oil seeds: Rape seed and mustard, safflower, Linseed, Niger - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Cereals	Rice, maize, wheat, barley, oats, rye and triticale
Millets	Sorghum, pearl millet, finger millet and minor millets
Pulses	Pigeonpea, green gram, black gram, cowpea, Chickpea, lentil and horse gram
Oilseeds	Groundnut, sesame, soybean, sunflower and castor Rapeseed and mustard, safflower and linseed

#### Practical

Identification of crops and crop varieties - Rice nursery preparation and transplanting - main field preparation for millets, pulses and oilseeds; Seed treatment techniques - Estimation of population - Sowing and manuring- Seeding equipment's - Study of growth and yield contributing characters, yield calculations, harvesting and yield estimation of above crops; Cost and returns - Study of cropping patterns and important agronomic experiments and farmers' fields.

#### References

1. Ahlawat, I.P.S., Om Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama publishing House, Meerut
2. Chidida Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi
3. Singh. S.S. 1997. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi
4. Daniel Sundararaj, D. and G.Thulasidas.(1993). Botany of Field Crops. (2nd Ed.). Macmilan India Ltd
5. Massod Ali, S.K.Chaturvedi and S.N.Gurha.2001. Pulses for sustainable agriculture and nutritional security.Indian Institute of Pulses Research, Kanpur, India.

6. Hand Book of Agriculture. 2006. Indian Council of Agrl. Research, New Delhi.
7. Crop Production Guide. 2005. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
8. Palaniappan, S.P. and K. Sivaraman, 1996. Cropping Systems in Tropics. Principles and Management, New Age Intel (P) Ltd., Publication.
9. Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.

Date	Theory schedule
	<ol style="list-style-type: none"> <li>1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.</li> <li>2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.</li> <li>3. Rice- Origin - geographic distribution - economic importance – varieties - soil and climatic requirement</li> <li>4. Rice - cultural practices – yield - economic benefits - Special type of Rice cultivation – Rajarajan 1000 (SRI), Transgenic Rice - Hybrid rice.</li> <li>5. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>6. Wheat and Barley - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>7. Oats, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>8. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>9. <b>Mid Semester Examination</b></li> <li>10. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>11. Pigeonpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>12. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses</li> <li>13. Chickpea, Lentil and Horse gram - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.</li> <li>14. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics</li> <li>15. Sunflower - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.</li> <li>16. Sesame and Castor – Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.</li> <li>17. Rapeseed, Mustard, Safflower, Niger and linseed - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.</li> </ol>

Date			Practical schedule
A	B	C	
			<ol style="list-style-type: none"> <li>1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria</li> <li>2. Practicing various nursery types and main field preparation for rice crop.</li> <li>3. Nursery and main field preparation for important millets, pulses and oilseeds</li> <li>4. Acquiring skill in different seed treatment techniques in important field crops</li> <li>5. Estimation of plant population per unit area for important field crops</li> <li>6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets</li> <li>7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.</li> <li>8. Acquiring skill in using seed drill for sowing operations.</li> <li>9. Acquiring skill in foliar nutrition for important field crops.</li> <li>10. Observations on growth parameters of cereals and millets</li> <li>11. Observations on growth parameters of pulses and oilseeds.</li> <li>12. Study of yield parameters and estimation of yield in cereals and millets.</li> <li>13. Study of yield parameters and estimation of yield in pulses and oilseeds.</li> <li>14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.</li> <li>15. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses and oilseeds.</li> <li>16. Visit to nearby Agricultural Research Station / Farmer's field.</li> <li>17. <b>Final Practical Examination.</b></li> </ol>

## Theory

### Unit I: Earth, Rocks and Minerals

Soil – Pedological and edaphological concepts – Origin of the Earth – Composition of Earth's crust - Rocks and minerals – primary and secondary minerals.

### Unit II: Soil Formation

Weathering of rocks & minerals - Physical, chemical and biological weathering – Soil formation - factors-active & passive. Soil forming processes - fundamental and specific soil forming processes- Soil profile.

### Unit III: Physical Properties

Phases of soil - Soil physical properties and their significance – Soil texture and textural classes - Soil structure and classification – Soil consistency

### Unit IV: Physical Properties

Bulk density, particle density and porosity - Soil colour – significance - causes and measurement. Soil temperature – Soil air – Soil water- Soil water potentials – Soil moisture constants – Movement of soil water – saturated and unsaturated flow – Infiltration, hydraulic conductivity, percolation, permeability and drainage

### Unit V: Chemical Properties, Organic matter and Humus

Soil colloids – Properties, types and significance – Layer silicate clays – their genesis and sources of charges – Ion exchange – CEC, AEC and Base saturation – Factors influencing Ion exchange - significance. Soil reaction, Buffering capacity and EC. Soil organic matter – Composition – decomposition and mineralization, C: N ratio, Carbon cycle – Fractions of soil organic matter – Humus formation. Soil organisms - Beneficial and harmful effects.

## Practical

Identification of rocks and minerals - Study of a soil profile - collection and processing of soil samples - Determination of bulk density, particle density and porosity – Particle size analysis – Feel method – International pipette method - Soil moisture determination – Gravimetric method, gypsum block, tensiometer, TDR and neutron probe moisture meter. Determination of infiltration rate and hydraulic conductivity - Soil colour – Munsell colour chart - Soil temperature. Soil pH and EC - Organic carbon - Chemical constituents of soil - Field study of different soil types.

### References

1. Brady, N.C., 2002 The Nature and Properties of Soils (13<sup>th</sup> Edition) McMillan Co., New York. Indian Publisher – Eurasia Publishing House (P) Ltd., Ramnagar, New Delhi – 55
2. Dilip Kumar Das. 2004. Introductory Soil Science, Kalyani Publishers, NewDelhi
3. Fundamentals of Soil Science.2009 .ISSS Publication, New Delhi.
4. Daji A.J., (1970) A Text Book of Soil Science - Asia Publishing House, Madras.
5. Biswas T.D. and Mukherjee S.K., 1987. Text Book of Soil Science–Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Jenny, H. 1941. Factors of Soil Formation - A System of Quantitative Pedology. McGraw-Hill Book Company INC. NewYork.
7. Joffe, J.S. 1936. The ABC of Soils. Pedology Publication, New Jersey.

### Web resources

1. [http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6V67-4C837XP\\_user=2945072&\\_coverDate=01/31/2005&\\_rdoc=1&\\_fmt=high&\\_orig](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V67-4C837XP_user=2945072&_coverDate=01/31/2005&_rdoc=1&_fmt=high&_orig)
2. <http://202.200.144.17/sykc/hjx/content/ckzl/6/2.pdf>
3. [http://www.pedosphere.com/volume01/pdf/Section\\_01.pdf](http://www.pedosphere.com/volume01/pdf/Section_01.pdf)
4. [http://waterquality.montana.edu/docs/homeowners/Septic\\_Drainfield\\_Soil\\_Suitability\\_Presentations/6\\_Soil\\_Texture\\_and\\_Structure.pdf](http://waterquality.montana.edu/docs/homeowners/Septic_Drainfield_Soil_Suitability_Presentations/6_Soil_Texture_and_Structure.pdf)
5. [http://wfrec.ifas.ufl.edu/landscape\\_horticulture/PDFdocuments/SoilProp.pdf](http://wfrec.ifas.ufl.edu/landscape_horticulture/PDFdocuments/SoilProp.pdf)
6. [http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20\(Feb%208\).pdf](http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20(Feb%208).pdf)
7. <http://www.soils.wisc.edu/courses/SS325/morphology.htm>

Date	Theory schedule
	<ol style="list-style-type: none"> <li>1. Soil definition – soil as a three dimensional natural body - pedagogical and edaphological concepts.</li> <li>2. Origin of Earth – theories – planetesimal and nebular hypothesis - Composition of Earth's crust.</li> <li>3. Rocks – definition, formation, classification – igneous, sedimentary and metamorphic rocks</li> <li>4. Brief description of important rocks – mineralogical composition</li> <li>5. Minerals – definition, occurrence, classification of important soil forming primary minerals - silicate &amp; non silicate minerals, ferro and non-ferro magnesium minerals</li> <li>6. Formation of secondary minerals – clay minerals and amorphous minerals</li> <li>7. Weathering of rocks and minerals – Physical, chemical and biological</li> <li>8. Soil profile description – master horizons – pedon and poly pedon</li> <li>9. Factors of soil formation - Active soil forming factors</li> <li>10. Factors of soil formation - Passive soil forming factors</li> <li>11. Fundamental soil forming process – elluviation, illuviation and humification.</li> <li>12. Specific Soil forming processes – podzolization, laterization, salinization, alkalization, calcification, decalcification, pedoturbation.</li> <li>13. Phases of soils – solid, liquid and gaseous phases – Properties of soil – defining the physical, chemical and biological properties</li> <li>14. Soil texture – particle size distribution – textural classes – textural triangular diagram – significance of soil texture</li> <li>15. Soil structure – classification – genesis - factors influencing structural stability – significance of soil structure</li> <li>16. Soil consistence – cohesion, adhesion, plasticity, Atterberg's constants – upper and lower plastic limits, plasticity number- significance of soil consistence</li> <li><b>17. Mid Semester Examination</b></li> <li>18. Soil bulk density, particle density and porosity – factors influencing – significance</li> <li>19. Soil colour – causes and measurement – Munsell colour chart – factors influencing soil colour – significance</li> <li>20. Soil temperature – measurement, soil air – composition - aeration, measurement - significance of soil temperature and soil air</li> <li>21. Soil water – forms of water, measurement, units of expression and pF scale</li> <li>22. Soil water potentials – gravitational, matric, osmotic – soil moisture constants</li> <li>23. Movement of soil water under saturated and unsaturated flow – infiltration, hydraulic conductivity, percolation, permeability and drainage</li> <li>24. Soil colloids – types, properties – inorganic colloids and organic colloids</li> <li>25. Layer silicate clays – genesis and classification – 1:1, 2:1 expanding and non expanding, 2:2 clay minerals, amorphous minerals</li> <li>26. Sources of charges in expanding and non expanding crystalline lattice clays, amorphous minerals and organic colloids</li> <li>27. Ion exchange reactions – cation exchange, anion exchange and base saturation - significance</li> <li>28. Soil reaction (pH) – definition, pH scale, factors affecting soil pH, buffering capacity - signification</li> <li>29. Soil Electrical Conductivity – factors affecting EC – significance</li> <li>30. Soil organic matter – composition, decomposition, mineralization and immobilization</li> <li>31. Carbon cycle, C : N ratio, biomass carbon and nitrogen</li> <li>32. Fractions of soil organic matter – humus formation and stabilization</li> <li>33. Soil organisms – soil flora and fauna –beneficial and harmful roles – earth worms – micro-organisms and their influence on soil properties</li> <li>34. Importance of soil properties in crop growth</li> </ol>

Date			Practical schedule
A	B	C	
			<ol style="list-style-type: none"> <li>1. Identification of common rocks and minerals</li> <li>2. Soil sample collection</li> <li>3. Visit to soils of different terrains and study of soil profiles</li> <li>4. Determination of bulk density, particle density and porosity – cylinder, wax coating and core methods.</li> <li>5. Soil textural analysis – feel method, International pipette method (part 1)</li> <li>6. International pipette method (part 2)</li> <li>7. International pipette method (part 3)</li> <li>8. Determination of soil colour and temperature.</li> <li>9. Determination of soil moisture– Gravimetric and gypsum block method</li> <li>10. Determination of soil moisture–Tensiometer, TDR and neutron probe</li> <li>11. Determination of Infiltration rate</li> <li>12. Determination of hydraulic conductivity</li> <li>13. Determination of soil pH and EC</li> <li>14. Estimation of soil organic carbon</li> <li>15. Colloquium 1. – Chemical constituents of soil – water soluble elements, total elemental composition – relevance in soil properties and behaviour</li> <li>16. Colloquium 2. – Preparation of interpretative reports of soil analysis and assignments</li> <li><b>17. Final Practical Examination</b></li> </ol>

## SST 201 Principles of Seed Technology 2+1

### Theory

#### Unit I: Introduction to Seed Production

Introduction to Seed Production – Difference between seed and grain -Importance of Seed Production – Seed policy – Seed demand forecasting and planning for certified, foundation and breeder seed production – Deterioration of crop varieties – Factors affecting deterioration and their control. Maintenance of genetic purity during seed production – Seed quality - Definition, Characters of good quality seed –Different classes of seed – Production of nucleus and breeder's seed – Maintenance and multiplication of pre-release and newly released varieties in self and cross –pollinated crops.

#### Unit II: Seed Production

Seed Production – Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites) –rice (varieties & hybrids) –sorghum and bajra (varieties, hybrids, synthetics and composites) - Pulses (Redgram- hybrid and varieties, blackgram and Greengram)- Groundnut –sunflower (varieties and hybrids) –castor (varieties and hybrids) cotton and - tomato and brinjal (varieties and hybrids) - chillies and bhendi (varieties and hybrids) - onion, bittergourd, ashgourd bottlegourd and ridgegourd (varieties and hybrids) - Seed certification, phases of certification, procedure for seed certification, field inspection and field counts etc.

#### Unit III: Post Harvest Handling

Seed Drying –, principles, moisture equilibrium between seed and air – Forced air seed drying - Heated air drying, types of air distribution systems for seed drying, selection of crop dryers, recommended temperature and depth of the seeds, management of seed drying – Planning and layout of seed processing plant. Establishment of seed processing plant. Seed processing – air screen machine and its working principle, different upgrading equipment and their use - Seed treatment –Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist –O-matic treater) - seed quality enhancement - Establishing seed testing laboratory. Seed testing procedures for quality assessment

#### Unit IV: Seed Storage and Marketing

Seed packing and seed storage – stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage – General principles of seed storage – construction features for good seed warehouse, measures for pest and disease control, temperature control – Seed marketing – marketing structure, marketing organization, sales generation activities, promotional media, pricing policy. Factors affecting seed marketing.

#### Unit V: Seed quality control

Seed Act and Rules -, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories. Seed Law Enforcement - duties and powers of seed inspectors, offences and penalties. Seed Control Order 1983, New Seed Bill 2004 and other issues related to seed quality regulation – intellectual property rights, patenting, WTO, plant breeders rights - Varietal Identification through Grow Out Test and Electrophoresis.



## **Practical**

Identification of seed and seed structure - Seed quality analysis in Field crops and Horticultural crops - Principles and procedures - Seed sampling — Physical purity analysis- Germination analysis - Moisture tests - Viability test - Seed health test - Vigour tests - Seed dormancy and breaking methods – Seed Quality enhancement - Grow out tests and electrophoresis for varietal identification - Planting ratios, isolation distance, rouging etc. - Visit to seed production plots - Visit to seed processing plants - Visit to seed testing laboratories - Varietal identification in seed production plots.

## **References**

1. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4<sup>th</sup> Ed. Chapman & Hall.
2. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
3. Bhaskaran, M. A.Bharathi, K.Vanangamudi, N.Natarajan, P.Natesan, R.Jerlin and K.Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.
4. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
5. Anon, 1965. Field Inspection Manual and Minimum Seed Certification Standards, NSC Publication, New Delhi.
6. Ramalingam, C., K. Sivasubramnaiam and A. Vijayakumar. 1997. A guide to seed legislation. Rassi Computers, Madurai.
7. Agrawal PK. (Ed.). 1993. Handbook of Seed Testing. Ministry of Agriculture, GOI, New Delhi.
8. Tunwar NS & Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

## **Web resources**

1. [www.gov.mb.ca](http://www.gov.mb.ca)
2. [www.agricoop.nic.in](http://www.agricoop.nic.in)
3. [www.agri.nic.in](http://www.agri.nic.in)
4. [www.fao.org](http://www.fao.org)

Date	Theory schedule
	<ol style="list-style-type: none"> <li>1. Introduction and Importance of Seed Production</li> <li>2. Seed policy and Seed demand forecasting</li> <li>3. Planning for certified, foundation and breeder seed production</li> <li>4. Deterioration of crop varieties – Factors affecting deterioration and their control. Maintenance of genetic purity during seed production</li> <li>5. Seed quality - Definition, Characters of good quality seed</li> <li>6. Different classes of seed – Production of nucleus and breeder’s seed</li> <li>7. Maintenance and multiplication of pre-release and newly released varieties in self and cross –pollinated crops</li> <li>8. Seed Production – Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites)</li> <li>9. Foundation and certified seed production of rice</li> <li>10. Foundation and certified seed production of sorghum and bajra</li> <li>11. Foundation and certified seed production of pulses (redgram, blackgram and greengram) and groundnut</li> <li>12. Foundation and certified seed production of sunflower and castor</li> <li>13. Foundation and certified seed production of cotton</li> <li>14. Foundation and certified seed production of tomato, brinjal and chillies</li> <li>15. Foundation and certified seed production of bhendi and onion</li> <li>16. Foundation and certified seed production of bittergourd, ashgourd, bottlegourd and ridgegourd</li> <li><b>17. Mid Semester Examination</b></li> <li>18. Seed certification, phases of certification, procedure for seed certification</li> <li>19. Field inspection and field counts</li> <li>20. Seed Drying –, principles, moisture equilibrium between seed and air – Forced air seed drying - Heated air drying, types of air distribution systems for seed drying, selection of crop dryers, recommended temperature and depth of the seeds, management of seed drying</li> <li>21. Planning, layout and establishment of seed processing plant</li> <li>22. Seed processing – air screen machine and its working principle, different upgrading equipment (specific gravity separator, indented cylinder separator, inclined draper, magnetic separator, spiral separator) and their use</li> <li>23. Seed treatment –Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist –O-matic treater)</li> <li>24. Seed quality enhancement (coating, pelleting, encrusting, treatments to remove dormancy, seed hardening, priming – sand, PEG, solid matrix and osmotic, fortification),</li> <li>25. Establishing a seed testing laboratory -Seed testing procedures (purity, germination, moisture content, vigor (Tz), testing for seed borne disease / pest) for quality assessment</li> <li>26. Seed packing and seed storage -Stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage – mid storage correction.</li> <li>27. General principles of seed storage – construction features for good seed warehouse, measures for pest and disease control, temperature control, Storage godown sanitation.</li> <li>28. Seed marketing – marketing structure, marketing organization, sales generation activities, promotional media, seed sales license, drill box survey, pricing policy</li> <li>29. Factors affecting seed marketing.</li> <li>30. Seeds Act, 1966 and Seeds Rules ,1968</li> <li>31. Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories</li> <li>32. Seed law enforcement -Duties and powers of seed inspectors, offences and penalties</li> <li>33. Seed Control Order 1983 – New Seed Bill 2004</li> <li>34. Varietal Identification through Grow Out Test and Electrophoresis</li> </ol>

Date			Practical schedule
A	B	C	
			<ol style="list-style-type: none"> <li>1. Identification of seed and seed structure</li> <li>2. Seed quality analysis in Field crops and Horticultural crops - Principles and procedures</li> <li>3. Seed sampling and physical purity analysis - (placing seeds for germination)</li> <li>4. Germination testing and seedling evaluation</li> <li>5. Moisture testing methods</li> <li>6. Viability testing methods</li> <li>7. Seed health testing</li> <li>8. Vigour testing (Electrical conductivity, Accelerated Ageing, Mean Germination Time, Vigor Index)</li> <li>9. Seed dormancy and breaking methods (Acid scarification, mechanical scarification, Alkali scarification, Hot water treatment, roasting over fire, warm and cold stratification)</li> <li>10. Seed Quality enhancement (egg floatation for rice, cotton delinting, procedures for pelleting, hardening, fortification, coating)</li> <li>11. Grow out tests and electrophoresis for varietal identification</li> <li>12. Selection of land, seed, seed management practices, Planting ratios, isolation distance, rouging, preharvest sanitation spray, drying, packing for processing.</li> <li>13. Visit to seed production plots</li> <li>14. Visit to seed processing plants</li> <li>15. Visit to seed testing laboratories</li> <li>16. Varietal identification in seed production plots.</li> <li><b>17. Final Practical Examination</b></li> </ol>



## **SWC 211 Fundamentals of Soil and Water Conservation Engineering 2+1**

### **Theory**

#### **Unit I: Surveying**

Surveying and Levelling – Chain, Compass and Plane Table survey – levelling – Land measurement and computation of area – Simpson’s rule and Trapezoidal rule.

#### **Unit II: Soil erosion**

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion - water erosion - causes - erosivity and erodibility - mechanics of water erosion - splash, sheet, rill and gully erosion - Ravines - Land slides – Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

#### **Unit III: Soil conservation**

Erosion control measures for Agricultural lands – biological measures – contour cultivation – strip cropping – cropping systems – vegetative barriers - windbreaks and shelterbelts - Shifting cultivation - mechanical measures – contour bund – graded bund – broad beds and furrows – basin listing – random tie ridging – Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall – gully control structures – permanent and temporary structures. Farm ponds – percolation ponds- Watershed Management.

#### **Unit IV: Irrigation and drainage**

Irrigation - Measurement of flow in open channels - velocity area method - Rectangular weir - Cippoletti weir - V notch - Orifices - Parshall flume - Duty of water - Irrigation efficiencies - Conveyance of irrigation water - canal lining - Underground pipe line system - Surface irrigation methods - Borders, furrows and check basins - Drip and sprinkler irrigation– Agricultural drainage - Surface drainage systems – Sub-Surface drainage systems - Drainage coefficient-design of open ditches.

#### **Unit V: Wells and Pumps**

Groundwater occurrence – aquifers – types of wells – pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps – selection of pumps – operation and their maintenance.

## **Practical**

Study of survey instruments - Chains and cross staff surveying - linear measurement - plotting and finding areas. Compass survey - observation of bearings - computation of angles- Radiation, intersection. Leveling – fly levels – determination of difference in elevation. Contouring – area and volume computation. Design of contour bund and graded bund. Visit to erosion affected areas. Problems on water measurement. Problems on duty of water, irrigation efficiencies. Problems on water requirement - Layout of Sprinkler and Drip systems. Agricultural drainage. Study of different types of wells and its selection. Study of reciprocating pump, centrifugal pump, submersible pumps & jet pumps- Selection of pumps.

## **References**

1. Kanetkar, T.P. & Kulkarni, S.V., 2004. “Surveying & levelling”. Part –I, A.V.G. Prakashan, Poona.
2. Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.
3. Gunshyam Das 2005, Hydrology and soil conservation engineering, Prentice-Hall of India Pvt. Ltd., New Delhi
4. Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.
5. Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.

## **Further reading**

1. Michael, A.M. and Ojha, T.P. 2006. Principles of Agricultural Engineering. Vol. II. Jain Brothers, New Delhi.

## **Journals**

1. ASCE journal of irrigation and drainage engineering
2. ISAE Journal of agricultural engineering
3. Journal of the Indian society of soil and water conservation published by CSWCRTI, Dehradun

## **Web resources**

1. <http://ocw.mit.edu/OcwWeb/Civil-and-Environmental-Engineering/1-72Fall-2005/LectureNotes/>
2. <http://www.eng.uwi.tt/depts/mech/ugrad/courses/31d.html>

Date		Theory schedule
I	II	
		<ol style="list-style-type: none"> <li>1. Introduction - Land surveying - Uses in agriculture.</li> <li>2. Chain cross staff and compass surveying - Computation of angles.</li> <li>3. Radiation, intersection and traversing.</li> <li>4. Dumpy level - setting, observation and tabulation of readings - computation of land slope - difference in elevation.</li> <li>5. Computation of area and volume – Simpson’s rule and Trapezoidal rule.</li> <li>6. Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion</li> <li>7. Water erosion - causes - erosivity and erodibility - mechanics of water erosion</li> <li>8. Splash, sheet, rill and gully erosion - Ravines - Land slides</li> <li>9. Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep</li> <li>10. Effects of water and wind erosion</li> <li>11. Erosion control measures for Agricultural lands – biological measures – contour cultivation – strip cropping</li> <li>12. Cropping systems–vegetative barriers - windbreaks and shelterbelts - Shifting cultivation</li> <li>13. Mechanical measures – contour bund – graded bund</li> <li>14. Broad beds and furrows – basin listing – random tie ridging</li> <li>15. Mechanical measures for hill slopes–contour trench–bench terrace–contour stone wall</li> <li>16. Gully control structures – permanent and temporary structures.</li> <li>17. <b>Mid Semester Examination.</b></li> <li>18. Farm ponds – percolation ponds.</li> <li>19. Irrigation - Measurement of flow in open channels - velocity area method</li> <li>20. Rectangular weir - Cippoletti weir - V notch</li> <li>21. Orifices - Parshall flume</li> <li>22. Duty of water - Irrigation efficiencies</li> <li>23. Conveyance of irrigation water - canal lining</li> <li>24. Underground pipe line system</li> <li>26. Surface irrigation methods - Borders, furrows and check basins</li> <li>26. Components of Drip and sprinkler irrigation system</li> <li>27. Agricultural drainage – need - Surface drainage systems</li> <li>28. Surface drainage systems - Drainage coefficient</li> <li>29. Groundwater occurrence – aquifers types</li> <li>30. Types of wells</li> <li>31. Pump types – Reciprocating pumps – Centrifugal pumps</li> <li>32. Turbine pumps – Submersible pumps</li> <li>33. Jet pumps – Airlift pumps</li> <li>34. Selection of pumps – operation and their maintenance.</li> </ol>

Date			Practical schedule
A	B	C	
			<ol style="list-style-type: none"> <li>1. Study of survey instruments - chains - compass - plane table - dumpy level.</li> <li>2. Chains and cross staff surveying - linear measurement - plotting and finding areas.</li> <li>3. Compass survey - observation of bearings - computation of angles.</li> <li>4. Compass - Radiation, intersection.</li> <li>5. Levelling – fly levels – determination of difference in elevation.</li> <li>6. Contouring – area and volume computation.</li> <li>7. Design of contour bund and graded bund.</li> <li>8. Visit to erosion affected areas.</li> <li>9. Problems on water measurement.</li> <li>10. Problems on duty of water, irrigation efficiencies.</li> <li>11. Problems on water requirement - agricultural drainage.</li> <li>12. Layout of Sprinkler and Drip systems.</li> <li>13. Study of different types of wells and its selection.</li> <li>14. Study of reciprocating pump &amp; centrifugal pump</li> <li>15. Study of submersible pumps &amp; jet pumps</li> <li>16. Selection of pumps.</li> <li>17. <b>Final Practical Examination.</b></li> </ol>



## FOR 211 Forest Resource Management 1+1

### Theory

#### Unit I: Forestry and Forest Regeneration

Indian forest – Forestry — Role of forests – Classification of forests -Silvics – silviculture – Locality factors – Regeneration of forests – Natural and artificial regeneration

#### Unit II: Silvicultural Techniques for Tree Species

Site selection - Choice of species - Modern silvicultural techniques in site preparation – Planting and tending operations – Mechanization in silviculture -Silvicultural packages for **Timber species**(Teak, Sal, Sandal wood Rosewood and sandal), **Pulpwood species** (Eucalyptus, Casuarina, Bamboo), **Fuel wood species** (Acacia's, Prosopis), (Ailanthus, Melia) **Tree borne oilseeds** (Neem, Pungam, Bassia), **Fodder trees** (Subabul, White babul). .

#### Unit III: Forest Utilization

Forest utilization – wood and non-wood forest products – Solid Wood- Timber- Wood composites- plywood, fibre board and particle boards – Non wood forest products

#### Unit IV: Agroforestry

Social Forestry concepts and applications –JFM concepts - Agroforestry- Agroforestry classification -Agroforestry systems for different agro climatic zones of Tamil Nadu –Distinction between social forestry and agroforestry

#### Unit V: Forestry types

Techniques and management of urbanforestry and recreation forestry – Ecotourism concepts and applications.

### Practical

Nursery layout and other nursery techniques – Nursery technology for Teak, Dalbergia, Neem, Eucalyptus. Casuarina, Bamboo and Acacia's – Clonal propagation methods - tree planting techniques – Tending and cultural operations -- Felling, transportation and conversion methods - Pulp and paper technology– Plywood production technology – Match manufacturing process –Social forestry - Agroforestry system .

### References

1. Brown, H. 1989. Indian wood technology. IBD Publishers, Dehra Dun.
2. Dwivedi, A.P. 1992. Agroforestry – Principles and practices. Oxford and IBH Publishing Co., New Delhi.
3. Khanna. L.S 1999 Principles and Practice of Silviculture, IBD Publishers, Dehra Dun
4. Negi. S.S.2008 Hand Book of Forestry, IBD Publishers, Dehra Dun

### Further reading

1. Heygreen, G. and J.L.Bowyer. 1982. Forest products and wood science. The Ohio State University Press, Ames.
2. Lal, J.B. 1992. India's forest – Myth and reality. Natraj Publishers, Dehra Dun.

### Journals

1. Indian Journal of Forestry
2. Indian Journal of Agroforestry

### Web resources

1. [www.ITTI.com](http://www.ITTI.com)
2. [www.swsc.com](http://www.swsc.com)
3. [www.Candia.com](http://www.Candia.com)
4. [www.ICRAF.com](http://www.ICRAF.com)
5. [www.Foris.com](http://www.Foris.com)

Date		Theory schedule
I	II	
		<p>1. Indian forest – forest – forestry – classification of forest Role of forests – production and protection role.</p> <p>2. Silvics – silviculture – Locality factors (climate, edaphic, physiographic and biotic factors).</p> <p>3. Regeneration techniques for forest trees – natural regeneration.</p> <p>4. Artificial regeneration – quality planting stock production techniques – clonal forestry techniques.</p> <p>5. Silvicultural techniques for some primary timber species – Teak, Sal, Rose wood and Sandal</p> <p>6. Silviculture techniques for some pulpwood species – Eucalyptus, Casuarina, Bamboo.</p> <p>7. Silvicultural techniques for some TBOs&amp; Fodder – Neem, Pungam, and Bassia,Subabul and white babul</p> <p>8. Silvicultural techniques for some fuel wood species – (Acacia’s, Prosopis) and match wood species ( Ailanthus and Melia)</p> <p>9. <b>Mid Semester Examination</b></p> <p>10. Forest utilization – Solid wood- timber and its products.</p> <p>11. Forest utilization – non wood forest products (fibres, flosses, grasses, bamboos and canes) – value addition to non wood forest products.</p> <p>12. Non wood forest products (oil, tannin, dyes, gum, resins) – status and value addition.</p> <p>13. Social forestry concepts,history, objectives and applications-JFM concepts</p> <p>14. Agroforestry –Agroforestry concepts,objectives and classifications - distiction between social forestry and agroforestry</p> <p>15. Agroforestry systems and their applications for different agro climatic zones of Tamil Nadu.</p> <p>16. Techniques for urban forestry ,Recreation forestry</p> <p>17. Eco-tourism – concepts and its application.</p>

Date			Practical schedule
A	B	C	
			<ol style="list-style-type: none"> <li>1. Nursery layout and other nursery techniques.</li> <li>2. Nursery technology for Teak and Sandal.</li> <li>3. Nursery technology for Rose wood</li> <li>4. Nursery technology for Eucalyptus</li> <li>5. Nursery technology for Casuarina.</li> <li>6. Nursery technology for Bamboo and Acacia</li> <li>7. Nursery technology for TBO's.</li> <li>8. Visit to a forest nursery to study the Nursery techniques</li> <li>9. Visit to a Agro forestry model unit.</li> <li>10. Clonal propagation techniques for forest trees.</li> <li>11. Practicing tree planting techniques.</li> <li>12. Practicing tending and cultural operations in forest plantations.</li> <li>13. Visit to Pulp and paper manufacturing industry</li> <li>14. Study of plywood production technology – visit to plywood industry.</li> <li>15 .Study of match manufacturing process – visit to matchwood industry.</li> <li>16. Visit to a NWFP value addition unit</li> <li>17. <b>Final Practical Examination.</b></li> </ol>

## **Theory**

### **Unit I: Agribusiness**

Agribusiness – Definition – Structure of Agribusiness (input, farm and product sectors)  
Agribusiness Management - Special features of Agribusiness - Importance of Agribusiness in Indian Economy.

### **Unit II: Management**

Management – Definition and Importance – Management functions – Nature. Management - Skills, Levels and functional areas of management. Forms of Business Organisation – Sole Proprietorship – Partnership – Private and Public Limited, Cooperatives.

### **Unit III: Management functions I**

Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget). Steps in planning – Characteristics of Sound plan. Objectives – MBO. Organizing – Principles of Organizing – Concept of Departmentation-Delegation- Centralization – Decentralization.

### **Unit IV: Management Functions II**

Staffing – Concept – Human Resource Planning – Process. Directing – Concept – Principles – Techniques, Supervision. Motivation – Concept - Maslow's "Need Hierarchy Theory – Types – Techniques. Communication – Definition and Process – Models – Types – Barriers. Leadership – Definition – Styles – Difference between leadership and management

### **Unit V: Management Functions III**

Controlling – Concept - Steps – Types – Importance – Process. Functional areas of business – Operations, Human Resources, Finance and Marketing – Scope and meaning. Laws and Policies related to Agri-Business.

### **Practical**

Exercise on Operations Management in agribusiness firms- Logistics Management- Inventory Management - Inventory types, costs and Economic Order Quantity- ABC analysis - Procurement systems and vendor rating methods- Exercise on Supply Chain Management. Market Research and Segmentation-Demand forecasting methods- Farmers survey – Buying behaviour of agricultural inputs - Market Promotion measures-Pricing methods. Exercises on Human Resource Planning and Management. Assessing and acquiring finance for agribusiness firms- Visit to agri hi-tech bank branch / commercial banks/RRB/ NABARD. Procedure and constraints in establishing agro based industries-New agribusiness venture proposal preparation

### **References**

1. Prasad, L.M, 2005, 'Principles and Practices of Management', Sultan Chand and Sons Educational Publishers, New Delhi.
2. Richard, B Chase, Nicholas J., Acquilano and F.Robert Jacobs, 2007, 'Production and Operations Management - Manufacturing and service, Tata Mc Graw Hill Publishing Company Limited, New Delhi.
3. Aswathappa, K, Human Resource Management: Text and Cases, Tata McGraw-Hill Pub. Co. Ltd. New Delhi, 5th Edition, 2008.
4. Philip Kotler, Marketing Management, Pearson Education, India, 2003.
5. Chandra Prasanna. 2000. Financial Management - Theory and Practice. Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
6. R.K.Sapru, Project Management, Excel Books, New Delhi, 1997.

### **Web resources**

1. [www.managementteacher.com](http://www.managementteacher.com)
2. [www.management.about.com](http://www.management.about.com)
3. [www.bized.co.uk](http://www.bized.co.uk)
4. <http://managementhelp.org/>
5. [www.fma.org](http://www.fma.org)
6. <http://www.ifmr.ac.in>

Date			Theory schedule
AG-1	AG-2	HORT	
			<ol style="list-style-type: none"> <li>1. Agribusiness – Definition – Structure of Agribusiness (input, farm and product sectors).</li> <li>2. Agribusiness Management - Special features of Agribusiness - Importance of Agribusiness in Indian Economy.</li> <li>3. Management – Definition and Importance – Management functions. Management - Skills, Levels and functional areas of management.</li> <li>4. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited, Cooperatives.</li> <li>5. Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget)</li> <li>6. Steps in planning – Characteristics of Sound plan. Objectives – MBO</li> <li>7. Organizing – Principles of Organizing – Organisation structure – Formal and Informal Organisation.</li> <li>8. Concept of Departmentation- Span of control – Authority and Responsibility – Concept and Meaning. Delegation- Centralization – Decentralization</li> <li><b>9. Mid Semester Examination</b></li> <li>10. Staffing – Concept – Human Resource Planning – Process.</li> <li>11. Directing – Concept – Principles – Techniques, Supervision.</li> <li>12. Motivation – Concept - Maslow’s Need Hierarchy Theory – Types – Techniques.</li> <li>13. Communication – Definition and Process – Models – Types – Barriers.</li> <li>14. Leadership – Definition – Styles – Difference between leadership and management</li> <li>15. Controlling – Concept - Steps – Types – Importance – Process.</li> <li>16. Functional areas of business – Operations, Human Resources, Finance and Marketing – Scope and meaning</li> <li>17. Laws and Policies related to Agri-Business.</li> </ol>

Date					Practical schedule
A	B	C	Hort-A	Hort-B	
					<ol style="list-style-type: none"> <li>1. Exercise on Operations Management in agribusiness firms</li> <li>2. Logistics Management</li> <li>3. Inventory Management - Inventory types, costs and Economic Order Quantity</li> <li>4. Procurement systems and vendor rating methods</li> <li>5. ABC analysis</li> <li>6. Exercise on Supply Chain Management</li> <li>7. Market Research and Segmentation</li> <li>8. Demand forecasting methods</li> <li>9. Visit to agri hi-tech bank branch / commercial banks/RRB/ NABARD</li> <li>10. Exercises on Human Resource Planning and Management</li> <li>11. Farmers survey – Buying behaviour of agricultural inputs</li> <li>12. Market Promotion measures</li> <li>13. Pricing methods</li> <li>14. Assessing and acquiring finance for agribusiness firms</li> <li>15. Procedure and constraints in establishing agro based industries</li> <li>16. New agribusiness venture proposal preparation</li> <li>17. <b>Final Practical examination</b></li> </ol>

## Theory

### Unit I: Basics in Plant Tissue Culture

History and concepts, Nutritional requirements, Morphogenesis-organogenesis and embryogenesis, Tissue culture techniques-Callus and suspension cultures, shoot tip and meristem tip culture, anther and pollen culture, ovule and embryo culture, endosperm culture and protoplast culture.

### Unit II: Basics in Molecular Biology

Structure of nucleic acids-an overview, central dogma of life - DNA replication, transcription and translation, fine structure of a gene, regulation of gene expression, polymerase chain reaction, blotting techniques, DNA sequencing methods.

### Unit III: Recombinant DNA Technology

Recombinant DNA, vectors: plasmids, phagemids, cosmids, BAC and YAC, DNA manipulation enzymes - polymerase, restriction endonucleases and ligases - construction of recombinant DNA molecules - Bacterial transformation.

### Unit IV: Genetic Transformation

Design of plant transformation vectors-selectable markers, reporter genes, promoters. Methods of gene transfer-direct: microinjection, electroporation, particle bombardment, indirect: *Agrobacterium* mediated gene transfer.

### Unit V: Immunotechnology

Antigens, antibodies and their structure, antigen-antibody interaction, monoclonal and polyclonal antibodies.

## Practical

Laboratory organization –sterilization techniques-Preparation of MS medium - Inoculation of explants - shoot tip and embryo culture-Extraction of plasmid and plant genomic DNA. DNA Quantification -quality assessment. Electrophoresis of DNA. Restriction digestion, ligation, competent cell preparation, bacterial transformation, blue white colony screening. *Agrobacterium* mediated transformation and confirmation of genetic transformants- PCR. Antigen-antibody interaction - Ouchterlony double immunodiffusion.

## References

1. Bhojwani, S.S. and Razdan, M.K. 2006. Plant Tissue Culture Studies – Theory and Practice. Elsevier Publication.
2. Gupta, P.K. 2005. Elements of Biotechnology. Rastogi Publication, India.
3. Malacinski, M. and D. Friefelder. 2003. Essentials of molecular biology. IV Ed. Jones and Bartlett publishers, Boston
4. Singh, B.D. 2004. Frontier areas in Biotechnology. Kalyani Publications, New Delhi.

## Further reading

1. Chawla, H.S. 2005. Introduction to plant biotechnooogy, India.
2. Lehninger. 2004. Principles of Biochemistry. CBS Publications, New Delhi.
3. Brown, T.A. 2006. Gene cloning - An introduction. V Ed. Chapman Hill, U.K.

## Web resources

1. [www.nal.usda.gov](http://www.nal.usda.gov).
2. [www.cellbio.com1](http://www.cellbio.com1)
3. <http://www.tamu-commerce.edu/coas/agscience/clasnote/pls497/PlantTissueWeb>
4. <http://www.uni-bonn.de/-ulp50bltissueculture.htm>
5. [www.nias.go.jp](http://www.nias.go.jp)

Date			Theory schedule
AG-1	AG-2	HORT	
			<ol style="list-style-type: none"> <li>1. History and concepts in plant tissue culture- totipotency, dedifferentiation and redifferentiation</li> <li>2. Nutritional requirements for plant tissue culture</li> <li>3. Morphogenesis- direct and indirect organogenesis and embryogenesis</li> <li>4. An overview about different tissue culture techniques -Callus and suspension cultures, shoot tip and meristem tip culture, anther and pollen culture</li> <li>5. Ovule and embryo culture, endosperm culture and protoplast culture</li> <li>6. Structure of nucleic acids</li> <li>7. Central dogma of life – replication, transcription and translation.</li> <li>8. Fine structure of gene and prokaryotic gene regulation - Lac operon</li> <li><b>9. Mid Semester Examination</b></li> <li>10. Polymerase Chain Reaction, blotting techniques and DNA sequencing methods</li> <li>11. Recombinant DNA, vectors - plasmids, phagemids, cosmids, BAC, YAC</li> <li>12. DNA manipulation enzymes- polymerase, restriction endonucleases and ligases</li> <li>13. Construction of recombinant DNA molecules and bacterial transformation</li> <li>14. Design of plant transformation vectors - selectable markers and reporter genes, promoters.</li> <li>15. Methods of gene transfer- microinjection, electroporation, particle bombardment, <i>Agrobacterium</i> mediated methods</li> <li>16. Antigens, antibodies and their structure, antigen-antibody interaction</li> <li>17. Monoclonal, polyclonal antibodies and hybridoma technology</li> </ol>



Date					Practical schedule
AG-A	AG-B	AG-C	Hort-A	Hort-B	
					<ol style="list-style-type: none"> <li>1. Laboratory organization and sterilization techniques</li> <li>2. Preparation of MS medium</li> <li>3. Inoculation of explant -shoot tip</li> <li>4. Embryo culture</li> <li>5. Preparation of reagents for plasmid and DNA isolation</li> <li>6. Isolation of plasmid DNA from bacteria</li> <li>7. Extraction of genomic DNA from leaf tissue</li> <li>8. Quantification of DNA by spectrophotometer</li> <li>9. Genomic DNA visualization using agarose gel electrohoresis</li> <li>10. Restriction digestion and ligation</li> <li>11. Competent cell preparation</li> <li>12. Bacterial transformation and blue white colony screening</li> <li>13. Demonstration of <i>Agrobacterium</i> mediated transformation method</li> <li>14. Amplification of DNA using thermocycler</li> <li>15. Analysis of PCR products in agarose gel electrophoresis</li> <li>16. Ouchterlony double immunodiffusion</li> <li>17. <b>Final Practical Examination.</b></li> </ol>

## STA 211 Applied Statistics 1+1

### Theory

#### Unit I: Descriptive Statistics

Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode – properties – Measures of dispersion: range, standard deviation, variance and coefficient of variation – properties. Computation of the above measures for raw data.

#### Unit II: Probability Distributions and Sampling Theory

Distributions – theoretical distribution – Binomial, Poisson and Normal distributions – definitions and properties.

Sampling theory – population – sample – parameter and statistic – sampling vs complete enumeration – deliberate sampling – simple random sampling – selection using random numbers.

#### Unit III: Tests of significance

Tests of significance – large sample test – single mean and difference between two means – single proportion and difference between two proportions. Small sample tests – t-test for testing the significance of single mean – independent t-test (equal variances only) and paired t test – chi square test for testing the association of a 2 x 2 contingency table.

#### Unit IV: Correlation and Regression

Correlation – Karl Pearson's correlation coefficient – computation – properties of correlation coefficient.

Regression – simple linear regression – fitting of simple linear regression equation of y on x – properties of regression coefficient.

#### Unit V: Analysis of Variance and Experimental Designs

Analysis of Variance (ANOVA) – assumptions – one way ANOVA – two way ANOVA. Experimental designs – randomization, replication and local control – Completely Randomised Design (CRD) (for equal replications) – Randomised Block Design (RBD) – Latin Square Design (LSD).

### Practical

Measures of central tendency – calculation of arithmetic mean, geometric mean, harmonic mean, median and mode for raw data – Measures of dispersion – calculation of standard deviation and variance for raw data – computation of coefficient of variation (CV) – **calculation of the above measures using MS Excel functions.**

Probability distributions – simple problems in Binomial, Poisson and Normal distribution  
– Sampling theory – selection of simple random sample using random numbers.

Testing of hypothesis – large sample test – single mean and difference between two means – single proportion and difference between two proportions – small samples test – t-test for testing the significance of single mean – testing the significance of two means for independent samples (equal variance only) and paired t test – chi square test for testing the association of a 2 x 2 contingency table.

Correlation – computation of correlation coefficient – Regression – fitting of simple linear regression equation – correlation and regression using MS Excel functions.

Experimental designs – analysis of completely randomised design (CRD) (for equal replications only), randomised block design (RBD) and Latin square design (LSD) – analysis of CRD, RBD and LSD using software package (AGRES).

### References

1. S.C. Gupta & V.K. Kapoor, Fundamentals of Applied Statistics, 2006, Sultan Chand & Sons, New Delhi.
2. Chandel, S.R.S., 1999, A hand book of Agricultural Statistics, Achal Prakashan Mandhir, Kanpur.
3. Gomez, K.A. and Gomez, A.A., 1984, Statistical Procedures for Agricultural Research, John Wiley and Sons, New York.
4. Sahu P.K., 2009, Agriculture and Applied Statistics-I and II, Kalyani Publishers, Ludhiana.
5. K.P. Dhamu and K. Ramamoorthy, 2007, Statistical Methods, Agrobios (India), Jodhpur.

### Further reading

1. G. Nageshwara Rao , 2007, Statistics for Agricultural Sciences, BS Publications, Andhra Pradesh.
2. Rangaswamy, R. 2009, A Text book of Agricultural Statistics, Wiley Eastern Limited, New Delhi.

### Web resources

1. <http://www.statistics.com/resources/glo.ssary/>
2. [www.statsoft.com](http://www.statsoft.com)
3. [http://www.iasri.res.in/ebook/EB\\_SMAR/index.htm](http://www.iasri.res.in/ebook/EB_SMAR/index.htm)
4. [www.stats.gla.ac.uk/steps/glossary/index.html](http://www.stats.gla.ac.uk/steps/glossary/index.html)
5. <http://davidmlane.com/hyperstat/>
6. <http://www.statrek.com/>
7. [http://www.businessbookmall.com/Statistics Internet Library.htm](http://www.businessbookmall.com/Statistics_Internet_Library.htm)
8. <http://www.stat-help.com/>
9. [www.statsci.org/jourlist.html](http://www.statsci.org/jourlist.html)

Date			Theory schedule
Ag-1	Ag-2	Hort	
			1. Introduction – definition of statistics – data – qualitative and quantitative classification – tabulation
			2. Measures of Central Tendency – definition – mean, geometric mean, harmonic mean median and mode for raw data – properties
			3. Measures of Dispersion – definition – range, standard deviation, variance and coefficient of variation for raw data – properties
			4. Distributions – Binomial distribution and Poisson distribution
			5. Normal distribution and standard normal distribution – definition – properties
			6. Population – sample – sampling – sampling vs complete enumeration – parameter and statistic – need for sampling – deliberate sampling – probability sampling method – simple random sampling – selection using random numbers
			7. Tests of significance – basic concepts – null and alternative hypothesis – level of significance – critical region – degrees of freedom – test statistic – types of errors – type I and type II error – standard error and its uses
			8. Large samples test – single mean and difference between two means – single proportion and difference between two proportions
			<b>9. Mid Semester Examination</b>
			10. Small sample tests – t-test for single mean and difference between two means for equal variances – paired t-test – chi square test for testing the association of a 2 x 2 contingency table
			11. Correlation – meaning – assumptions – scatter diagram – types – positive and negative correlation – Karl Pearson’s correlation coefficient – definition – computation and interpretation of correlation coefficient – properties of correlation coefficient – uses of correlation analysis
			12. Regression – meaning – cause and effect – simple linear regression – regression coefficients – definition – fitting of simple linear regression equation y on x – properties of regression coefficient – uses of regression analysis.
			13. Analysis of Variance – definition – assumptions – uses – one way and two way ANOVA
			14. Experimental designs–basic concepts–experiment, experimental unit, treatment, block, experimental error–Principles of experimental design – randomization, replication, local control
			15. Completely Randomised Design (CRD) – for equal replications only – randomization – analysis (one way analysis of variance)
			16. Randomised Block Design (RBD) – randomization – analysis (two way analysis of variance)
			17. Latin Square Design (LSD) – randomization – analysis

Date					Practical schedule
Ag-A	Ag-B	Ag-3	Hort-A	Hort-B	
					1. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode for raw data
					2. Computation of range, standard deviation, variance, coefficient of variance for raw data – calculation of the above measures using MS Excel functions
					3. Simple problems in Binomial distribution and Poisson distribution
					4. Simple problems in Normal distribution
					5. Selection of sample using simple random sampling method
					6. Large sample test – test for single proportion and difference between two proportions
					7. Large sample test – test for single mean and difference between two means
					8. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only)
					9. Paired t-test
					10. Chi square test for testing the association of a 2 x 2 contingency table
					11. Computation of Karl Pearson's correlation coefficient
					12. Fitting of simple linear regression equation y on x – correlation and regression using MS Excel functions
					13. Analysis of Completely Randomised Design (CRD) – for equal replications only
					14. Analysis of Randomised Block Design (RBD)
					15. Analysis of Latin Square Design (LSD) – analysis of CRD, RBD and LSD using statistical package (AGRES).
					16. Field visit
					<b>17. Final Practical Examination</b>

## Theory

### Unit I: Energy scenario

Introduction -energy crisis -energy sources- classification -availability-renewable energy sources- significance- potential and achievements in India. Energy requirements of important agricultural crops.

### Unit II: Methods of energy conversion and Biogas Technology

Methods of energy conversion – thermochemical and biochemical conversion methods-combustion, pyrolysis and gasification - applications- biogas and ethanol production-applications.

Biogas technology-Science of production -feed stocks - factors affecting biogas production- types and capacity of biogas plants- KVIC, Janata and Deenbandhu model biogas plants- construction and working principles- comparison features of biogas plants. Applications of biogas – biogas requirements-biogas appliances-environmental considerations – enrichment and uses of biodigested slurry(BDS).

### Unit III: Thermochemical conversion methods

Principles of combustion, pyrolysis and gasification – types of gasifiers – producer gas and its utilization. Briquettes – types of briquetting machines – uses of briquettes – shredders.

### Unit IV: Applications of solar energy

Solar energy – solar flat plate and focusing plate collectors – solar air heaters – solar space heating and cooling – solar energy applications/ solar energy gadgets – solar cookers – solar water heating systems – solar grain dryers – solar refrigeration system – solar ponds – solar photo voltaic systems – solar lantern - solar street lights – solar fencing – solar pumping systems.

### Unit V: Wind energy, energy plantation and bio-fuels

Wind energy - types of wind mills – constructional details and applications. Energy crops-definition and use of energy plantation- availability- selection of species -calorific value and rating index- calculation of area needed for power production from energy crops. Energy from agricultural wastes –liquid Bio fuels -bio diesel and ethanol from agricultural produce – its production & uses.

### References

1. Renewable Energy, [Godfrey Boyle \(Editor\)](#) ISBN: 0199261784 / ISBN-13: 9780199261789.
2. Solar Energy Utilization, Rai G.D 1984 Khanna Publishers, New Delhi
3. Solar Energy, Sukhatme SP 1985. Tata McGraw Hill publishing Co. Ltd., New Delhi.
4. Energy technology - Non conventional, renewable and conventional, Rao, S. and B.B. Parulekar, 2002. Khanna Publishers, New Delhi, India.
5. [Renewable Energy Resources](#) , John Twidell and Tony Weir - (Paperback - 24 Nov 2005).
6. Biotechnology and other Alternate Technology, Chakravarthy A 1989. Oxford and IBH Publishing Co. Ltd. New Delhi.

### Further reading

1. Renewable Energy Sources and Conversion Technology, Bansal N.K.et al 1990. Tata McGraw Hill publishing Co.Ltd., New Delhi.
2. Non Conventional Energy Sources, Rai GD 1996. Khanna publishers, New Delhi.
3. Biomass Briquetting and utilization, Srivastava et al 1995 Jain Brothers New Delhi 110 005.

### Web resources

1. Journal of Renewable and Sustainable Energy - <http://jrse.aip.org/>
2. Renewable Energy - An International Journal - ISSN: 0960-1481 Imprint- ELSEVIER [http://www.elsevier.com/wps/find/journaldescription.cws\\_home/969/](http://www.elsevier.com/wps/find/journaldescription.cws_home/969/)
3. Bioresource Technology - International Journal - <http://www.sciencedirect.com/>
4. Ministry of New and Renewable Energy - <http://www.mnre.gov.in/>

Date			Theory schedule
Ag-1	Ag-2	Hort	
			<ol style="list-style-type: none"> <li>1. Energy crisis-renewable energy sources- significance-potential and achievements in India-energy requirements of important crops like banana, mango, areca nut, coconut, etc.</li> <li>2. Methods of energy conversion – thermo chemical conversion methods-principles of combustion, pyrolysis and gasification and applications-biochemical conversion methods – biogas and ethanol production-principles-applications.</li> <li>3. Biogas technology-science of production of biogas-feed stocks used - factors affecting biogas production- types of biogas plants- capacity determination.</li> <li>4. Biogas plants - construction and working principles – KVIC, Janata and Deen bandhu model biogas plants-performances.</li> <li>5. Applications of biogas – biogas requirements for cooking , lighting and engine operation and electricity production- biogas appliances-environmental considerations - enrichment and uses of biodigested slurry(BDS).</li> <li>6. Combustion-improved chulha –single pot chulha – double pot chulha-conventional chulha- biomass gas stove- constructional features, working principles and applications.</li> <li>7. Thermo-chemical conversion – principle –chemistry of gasification-gasifiers –types- operation -applications</li> <li>8. Briquetting-definition-MED, VED –need for briquetting- benefits of biomass briquettes -elemental composition and physical properties of agro-residues -densification methods.</li> <li><b>9. Mid Semester Examination</b></li> <li>10. Briquetting machines – types - principles, features and operation - properties and uses of briquettes.</li> <li>11. Solar Energy-characteristics of solar radiation- advantages and disadvantages- types of radiation- solar constant-</li> </ol>

			<p>availability of solar radiation-solar thermal devices – solar water heaters – principle and applications -solar cookers-evacuated tube collector.</p> <p>12. Solar driers – natural and forced convection types – working principle –drying of agro-produces in natural as well as forced convection type solar dryers.</p> <p>13. Solar PV systems – principle-water pumping applications-solar lantern-principle.</p> <p>14. Solar refrigeration- advantages- applications- absorption refrigeration -principle- ammonia-water and Lithium bromide absorption refrigeration systems -solar mechanical refrigeration. Solar pond-principle-types-applications-solar distillation- principle-applications.</p> <p>15. Energy available in wind -wind mills -types-water pumping windmills –components- wind power transmission - controls-applications-aerogenerator - components –working principle –types of rotors- wind power transmission - power generation –controls-applications.</p> <p>16. Energy crops-definition and use of energy plantation-availability-advantages and disadvantages of energy plantation - selection of species -calorific value and rating index- calculation of area needed for power production from energy crops.</p> <p><b>17. Bio-fuels –Importance-use in agricultural sector –demand and growth of bio-fuels- biodiesel production method-flowchart-components-byproducts-utilization-TNAU biodiesel pilot plant.. Bio-ethanol -principle of production from cellulosic substances-flowchart – effects of different parameters on ethanol fermentation –types of fermenters-ethanol from sugar substrates-applications in agriculture.</b></p>
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## **AGR 204 Study Tour – I 0+1**

The students will undertake the short tour during third semester for seven days covering KVK's, Research stations, Sister campuses and ICAR institutes in the southern part of Tamil Nadu. The study tour will provide an exposure to the students to know about the soil, climatic conditions and cropping patterns in the respective agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

## **Theory**

### **Unit I: Mulberry production**

Importance and history of sericulture – organizations involved in sericulture – silkworm types- Mulberry cultivation – varieties - Morphology of mulberry plant – Identification of popular mulberry genotypes – Methods of propagation – Nursery and main field preparation – planting methods – Identification of nutrient deficiency symptoms – identification of weeds – herbicide application methods – Irrigation methods and management practices

### **Unit II: Mulberry protection**

Pruning and harvesting – Pests, diseases and nematodes of mulberry and their management.

### **Unit III: Silkworm biology**

Mulberry silkworm – origin – classification based on voltinism, moultnism, geographical distribution and genetic nature – Pure races – multivoltine, bivoltine - cross breeds – bivoltine hybrids – double hybrids - Morphology and biology of silkworm – mouth parts of larva –sex limited characters – Anatomy and physiology of digestive and excretory systems of larva – structure and function of silk glands.

### **Unit IV: Silkworm rearing**

Rearing house – types – disinfection – room and bed disinfectants – Egg incubation methods – Chawki rearing – feeding, cleaning and spacing – Rearing of late age worms – feeding, cleaning, spacing and moulting care different stages – spinning – Mountages – harvesting. Visit to sericulture farms – Interaction with sericulturists- Visit to grainage and cocoon market- Economics of mulberry silkworm rearing.

### **Unit V: Non mulberry silkworms**

Pests and diseases of silkworm and their management – Post cocoon technology – stifling to weaving. Byproducts of sericulture - Non –mulberry silkworms – Eri, Tasar and Muga silkworms.

#### **Assignment:**

1. Rearing of 50 larvae of silkworm from larva to cocoon by each student
2. Group assignments and individual assignments on various aspects of Sericulture.

#### **References**

1. CSB. 2003. Seri Business Manual- Vol. III Farm & Industry Sectors, Central Silk Board, Bangalore.
2. Dandin, S.B., J.Jayaswal and K. Giridhar.2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore, 287 p.
3. Jolly, M.S., S.K. Sen, T.N. Sonwalkar and G.K. Prasad 1980. Non – mulberry Silks. FAO Agricultural Services Bulletin 29. Food and Agriculture Organisation of the United Nations, Rome, 178 p.
4. Krishnaswami,S., M.N. Narasimhanna, S.K Suryanarayan and S.Kumararaj. 1978. Seiculture Manual 2 and 3 – Silkworm Rearing . FAO Agricultural Services Bulletin 15/2. Food and Agriculture Organisation of the United Nations, Rome, 131 p.
5. Rangaswami, G.,M.N.Narasimhanna, K.Kasiviswanathan, C.R.Sastry and M.S. Jolly. 1978. Sericulture Manual 1 – Mulberry Cultivation. FAO Agricultural Services Bulletin 15/1. Food and Agriculture Organization of the United Nations, Rome, 150 p.

#### **Journals**

1. Indian Journal of Sericulture – published from CSR&TI, Mysore
2. Indian Silk – published from Central Silk Board, Bangalore

#### **Web resources**

1. [www.silkbase.org](http://www.silkbase.org)
2. [www.papilo.ab.a.u.tokyo.ac.jp](http://www.papilo.ab.a.u.tokyo.ac.jp)

Date			Theory schedule
Ag-1	Ag-2	Hort	
			<ol style="list-style-type: none"> <li>1. Importance of sericulture – History of sericulture – silk road – Organizations in sericulture industry – Mulberry – origin – species – Morphology of mulberry plant – importance of different morphological characters influencing leaf yield.</li> <li>2. Ecological requirements for mulberry cultivation – soil type – mulberry varieties – Methods of propagation – merits and demerits – selection of semi hard wood cuttings – Nursery preparation – Main field preparation – methods of planting – pit, row, paired row and Kolar system of planting – merits and demerits.</li> <li>3. Nutritional requirements – organic, inorganic and biofertilizers – Intercropping – Water management – Types of weeds and their management.</li> <li>4. Pruning methods – bottom, middle, Kolar or strip system of pruning – Methods of harvesting – preservation of leaves.</li> <li>5. Pests of mulberry – foliage feeders – sucking insects – subterranean insects – management of pests.</li> <li>6. Diseases of mulberry – foliar diseases – soil borne pathogens – Nematodes - management of diseases and nematodes.</li> <li>7. Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultnism, geographical distribution and genetic nature – Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids – double hybrids– suitability for rearing in different seasons.</li> <li>8. Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm</li> </ol>

			<p>genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use.</p> <p><b>9. Mid Semester Examination</b></p> <p>10. Anatomy of digestive system – physiology of digestion and excretion – silk glands – silk synthesis – physico chemical properties of silk.</p> <p>11. Rearing house – types – Hygienic rearing – Methods of disinfection – disinfectants – Egg transportation and incubation methods – black boxing.</p> <p>12. Environmental requirements for different stages of silkworm – Chawki rearing – Concept of Community Chawki Rearing Centres (CRC) - brushing – spacing – feeding - cleaning – selection of leaves for feeding – care during feeding, moulting, mounting and bed cleaning.</p> <p>13. Rearing of late age worms – different methods – floor, shelf and shoot feeding – cleaning – spacing – mounting – Different mountages – merits and demerits – spinning – harvesting of cocoons.</p> <p>14. Pests of silkworm – uzifly – dermestid beetle – management practices.</p> <p>15. Diseases of silkworm – pebrine – flacherie – grasserie – muscardine – pathological symptoms - management practices.</p> <p>16. Post cocoon technology – selection of cocoons – methods of stifling – cooking for different races – Reeling devices – charka – cottage basin – multi end reeling machine – automatic reeling centres – advantages – re reeling – twisting – degumming – dyeing – weaving – SMOI - By product utilization.</p> <p>17. Non – mulberry silkworm – Eri, Tasar and Muga Silkworms – food plants – rearing methods.</p>
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Date					Practical schedule
Ag-A	Ag-B	Ag-C	Hor-A	Hor-B	
					<ol style="list-style-type: none"> <li>1. Morphology of mulberry plant – description – distinguishing characters of promising mulberry genotypes. Nursery bed preparation – care in selection of planting materials – Biofertilizer treatment in nursery.</li> <li>2. Main field preparation – methods of planting, methods of irrigation - Identification of nutrient deficiency symptoms – corrective measures.</li> <li>3. Identification of weeds – Herbicide application method. Pruning methods – leaf / shoot harvest– preservation of leaves.</li> <li>4. Identification of pests of mulberry and damage symptoms.</li> <li>5. Identification of symptoms of diseases and nematodes of mulberry.</li> <li>6. Morphology of silkworm – different stages – Identification of races by cocoon shape, colour and larval marking –Dissection of mouth parts and silk glands.</li> <li>7. Rearing house and appliances – Methods of disinfection. Incubation of eggs – methods – Chawki rearing – brushing – feeding.</li> <li>8. Silkworm rearing – shelf and shoot rearing – skill involved in brushing – feeding- moulting care – bed cleaning – spacing – mountages — spinning and cocoon harvest.</li> <li>9. Identification of pests and diseases of silkworm – damage – symptoms - Mass multiplication of hyperparasitoid.</li> </ol>

				<p>10. Integrated Farm System with Sericulture in Integrated Farming system – Mechanization in sericulture.</p> <p>11. Visit to grainage and cocoon market – observing the activities involved in selection of parent races – pairing – depairing - egg collection – acid treatment– cold storage – mother moth testing – fixing up of cocoon price – auction procedures.</p> <p>12. Visit to silk reeling centre – observing various processes – stifling – cooking – reeling – rereeling – winding – rewinding – bleaching – dyeing – weaving – silk grades – Byproducts from reeling units.</p> <p>13. Eri silkworm – morphology – food plants – methods of rearing – methods of spinning –Tasar silkworm – morphology – food plants – early and late instar larval rearing.</p> <p>14. Economics of silkworm rearing.</p> <p>15. Visit to CSR&amp;TI, Mysore; CSB, CSTRI, SSSL and SBRL Institutes at Bangalore.</p> <p>16. Visit to sericulture farms – Interaction with sericulturists.</p> <p><b>17. Final Practical Examination.</b></p>
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