# COURSE SYLLABUS

# FOR

# M.Sc. FORESTRY & ENVIRONMENTAL SCIENCES

(w. e. f. 2015-16)

## "SCHOOL OF NATURAL RESOURCES"

## DEPARTMENT OF FORESTRY, WILDLIFE & ENVIRONMENTAL SCIENCES


GURU GHASIDAS VISHWAVIDYALAYA

BILASPUR-495009, CHHATTISGARH

(A Central University established by the Central University Act.2009 No. 25 of 2009)

## DEPARTMENT OF FORESTRY, WILDLIFE & ENVIRONMENTAL SCIENCES
## GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR, CG

**SEMESTER-WISECHOICE BASED CREDIT SYSTEM OF M.Sc. FORESTRY& ENVIRONMENTAL SCIENCES**

| **M.Sc. I[st] Semester** | | | | | |
|---|---|---|---|---|---|
| S.No. | Title of Paper | Lecture | Tutorial | Practical | Credit |
| 01. | Silviculture | 3 | -- | 1 | 4 |
| 02. | Forest Biometry, Surveying & Engineering | 3 | -- | 1 | 4 |
| 03. | Forest Management, Remote Sensing & GIS | 2 | 1 | 1 | 4 |
| 04. | Forest Ecology and Biodiversity Conservation | 3 | -- | 1 | 4 |
| 05. | Forest Protection | 3 | -- | 1 | 4 |
| 06. | Forest Statistics & Research Methodology | 3 | 1 | 1 | 5 |
| | | | | | |
| | | | **Total Credits** | | **25** |

| **M.Sc. II[nd] Semester** | | | | | |
|---|---|---|---|---|---|
| S.No. | Title of Paper | Lecture | Tutorial | Practical | Credit |
| 01. | Forest Policy, Laws and Environmental Legislation | 2 | 1 | 1 | 4 |
| 02. | Forest Tree Improvement and Biotechnology | 3 | -- | 1 | 4 |
| 03. | Wood Technology and Nanoforestry | 3 | -- | 1 | 4 |
| 04. | Wildlife Biology and Conservation | 3 | -- | 1 | 4 |
| 05. | Forest Soil and Watershed Management | 3 | -- | 1 | 4 |
| 06. | Forest Products and Industries | 3 | -- | 1 | 4 |
| 07. | Environment and Global Climatic Changes | 3 | -- | 1 | 4 |
| | | | | | |
| | | | **Total Credits** | | **28** |

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## SPECIALIZATION

## FOREST GENETIC RESOURCES (FGR)

| M.Sc. III[rd] Semester | | | | | |
|---|---|---|---|---|---|
| S.No. | Title of Paper | Lecture | Tutorial | Practical | Credits |
| 01. | Breeding Methods in Forest Trees | 3 | --- | 1 | 4 |
| 02. | Forest Trees Reproductive Biology and Seed Orchards | 3 | --- | 1 | 4 |
| 03. | Molecular Genetics of Forest Trees | 3 | --- | 1 | 4 |
| 04. | Quantitative Geneticsof Forest Trees | 3 | --- | 1 | 4 |
| 05. | Forest Genetic Diversity, Conservation & Environmental Impact | 3 | --- | 1 | 4 |
| | | **Total Credits** | | | **20** |

| M.Sc. IV[th] Semester | | |
|---|---|---|
| S.No. | Title of Paper | Credits |
| 01. | Field Training ( Attachment with State Forest Department for analysis of FGR & its distribution) Project report writing, Presentation & Viva-voce | 10 |
| 02. | Industrial Training<br>Project report writing, Presentation & Viva-voce | 09 |
| 03. | Computational Skills | 05 |
| 04. | Student Project | 01 |
| | **Total Credits** | **25** |

**Grand Total of Credits = 98**

- The student project will be allotted in III semester and will be evaluated at the end of IV semester. Students may choose any project related to their curriculum. There will be no supervisor for the project.
- **Visits:** Visits to forest operation sites, forest nursery, wildlife habitat and plantation sites will be conducted as per the requirement of curriculum.

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## SPECIALIZATION

## FOREST MANAGEMENT (FM)

| M.Sc. III[rd] Semester | | | | | |
|---|---|---|---|---|---|
| S.No. | Title of Paper | Lecture | Tutorial | Practical | Credits |
| 01. | Forest Resource Analysis | 3 | --- | 1 | 4 |
| 02. | Production Management in Nursery and Plantation Forestry | 3 | --- | 1 | 4 |
| 03. | Finance and Marketing Management of Forest Resources | 3 | --- | 1 | 4 |
| 04. | Tree BusinessManagement | 3 | --- | 1 | 4 |
| 05. | Forest Management for Environmental Conservation | 3 | --- | 1 | 4 |
| | | **Total Credits** | | **20** | |

| M.Sc. IV[th] Semester | | |
|---|---|---|
| S.No. | Title of Paper | Credits |
| 01. | Field Training ( Attachment with State Forest Department for analysis of Forest Management patterns & Management techniques) | 10 |
| 02. | Industrial Training<br>Project report writing, Presentation & Viva-voce | 09 |
| 03. | Computational Skills | 05 |
| 04. | Student Project | 01 |
| | **Total Credits** | **25** |

**Grand Total ofCredits = 98**

- The student project will be allotted in III semester and will be evaluated at the end of IV semester. Students may choose any project related to their curriculum. There will be no supervisor for the project.
- **Visits**: Visits to forest operation sites, forest nursery, wildlife habitat and plantation sites will be conducted as per the requirement of curriculum.

## MARKS DISTRIBUTION FOR M.Sc. FORESTRY & ENVIRONMENTAL SCIENCES PROGRAMME

## (2 YEARS / 4 SEMESTERS)

| **M.Sc. I[st] Semester** | | **Marks** | | |
|---|---|---|---|---|
| S.No. | Title of Paper | Main Semester Exam | Internal Assessment | Total |
| 01. | Silviculture | 60 | 40 | 100 |
| 02. | Forest Biometry, Surveying & Engineering | 60 | 40 | 100 |
| 03. | Forest Management, Remote Sensing & GIS | 60 | 40 | 100 |
| 04. | Forest Ecology and Biodiversity Conservation | 60 | 40 | 100 |
| 05. | Forest Protection | 60 | 40 | 100 |
| 06. | Forest Statistics & Research Methodology | 60 | 40 | 100 |
| 07. | Practical | | | 200 |
| | **Total** | | | **800** |

| **M.Sc. II[nd] Semester** | | **Marks** | | |
|---|---|---|---|---|
| S.No. | Title of Paper | Main Semester Exam | Internal Assessment | Total |
| 01. | Forest Policy, Laws and Environmental Legislation | 60 | 40 | 100 |
| 02. | Forest Tree Improvement and Biotechnology | 60 | 40 | 100 |
| 03. | Wood Technology and Nanoforestry | 60 | 40 | 100 |
| 04. | Wildlife Biology and Conservation | 60 | 40 | 100 |
| 05. | Forest Soil and Watershed Management | 60 | 40 | 100 |
| 06. | Forest Products and Industries | 60 | 40 | 100 |
| 07. | Environment and Global Climatic Changes | 60 | 40 | 100 |
| 08. | Practical | | | 200 |
| | **Total** | | | **900** |

## SPECIALIZATION

## FOREST GENETIC RESOURCES (FGR)

| M.Sc. III[rd] Semester | | Marks | | |
|---|---|---|---|---|
| S.No. | Title of Paper | Main Semester Exam | Internal Assessment | Total |
| 01. | Breeding Methods in Forest Trees | 60 | 40 | 100 |
| 02. | Forest Trees Reproductive Biology and Seed Orchards | 60 | 40 | 100 |
| 03. | Molecular Genetics of Forest Trees | 60 | 40 | 100 |
| 04. | Quantitative Geneticsof Forest Trees | 60 | 40 | 100 |
| 05. | Forest Genetic Diversity, Conservation & Environmental Impact | 60 | 40 | 100 |
| 06. | Practical | | | 200 |
| | **Total** | | | **700** |

| M.Sc. IV[th] Semester | | Marks |
|---|---|---|
| S.No. | Title of Paper | Total |
| 01. | Field Training ( Attachment with State Forest Department for analysis of FGR & its distribution) Project report writing, Presentation & Viva-voce | 150 |
| 02. | Industrial Training<br>Project report writing, Presentation & Viva-voce | 150 |
| 03. | Computational Skills | 50 |
| 04. | Student Project | 50 |
| | **Total** | **400** |
| | **GRAND TOTAL** | **2800** |

- Internal assessment marks distribution will be as given below:
  - 01. Midterm test - 30 Marks
  - 02. Attendance - 05 Marks
  - 03. Assignment - 05 Marks
  - **Total - 40 Marks**
- Forest & Industrial visits/ Training, Forestry Operation (working experience) and Socio economic survey – village attachment will be evaluated by one external examiner from the outside of the Vishwavidyalaya and two Internal Examiners from the Department.
- Student project will be evaluated by a pannel of two Departmental teachers.
- Practical examination for each class will be evaluated by two teachers of the Department.
- Minimum passing marks for each theory paper will be 40 %.
- Minimum passing marks for each Student project, practical, training programme, attachment programme, Village surveys etc. will be 40%.

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## SPECIALIZATION

## FOREST MANAGEMENT (FM)

| M.Sc. III[rd] Semester | | Marks | | |
|---|---|---|---|---|
| S.No. | Title of Paper | Main Semester Exam | Internal Assessment | Total |
| 01. | Forest Resource Analysis | 60 | 40 | 100 |
| 02. | Production Management in Nursery and Plantation Forestry | 60 | 40 | 100 |
| 03. | Finance and Marketing Management of Forest Resources | 60 | 40 | 100 |
| 04. | Tree BusinessManagement | 60 | 40 | 100 |
| 05. | Forest Management for Environment Conservation | 60 | 40 | 100 |
| 06. | Practical | | | 200 |
| | **Total** | | | **700** |

| M.Sc. IV[th] Semester | | Marks |
|---|---|---|
| S.No. | Title of Paper | Total |
| 01. | Field Training ( Attachment with State Forest Department for analysis of Forest Management patterns & Management techniques) | 150 |
| 02. | Industrial Training<br>Project report writing, Presentation & Viva-voce | 150 |
| 03. | Computational Skills | 50 |
| 04. | Student Project | 50 |
| | **Total** | **400** |
| | **GRAND TOTAL** | **2800** |

- Internal assessment marks distribution will be as given below:
  - 04. Midterm test - 30 Marks
  - 05. Attendance - 05 Marks
  - 06. Assignment - 05 Marks
  - **Total - 40 Marks**
- Forest & Industrial visits/ Training, Forestry Operation (working experience) and Socio economic survey – village attachment will be evaluated by one external examiner from the outside of the Vishwavidyalaya and two Internal Examiners from the Department.
- Student project will be evaluated by a pannel of two Departmental teachers.
- Practical examination for each class will be evaluated by two teachers of the Department.
- Minimum passing marks for each theory paper will be 40 %.
- Minimum passing marks for each Student project, practical, training programme, attachment programme, Village surveys etc. will be 40%.

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## SEMESTER-I

**PAPER I. SILVICULTURE** **CR.4 (3+1)**

**Objective**

To provide knowledge about Forest ecosystem concept, stand dynamics forest succession, productivity and vegetation forms and natural regeneration of tree species.

**Theory**

Principles of Silviculture, Forest structure and their components. Forest ecosystem concept, Stand dynamics-forest succession, competition and tolerance, classification of world's forest vegetation. Forest types and their distribution.Ecophysiology of tree growth, effects of radiation and water relationship, mineral nutrient and temperature.Bioclimate and microclimate effect.Natural regeneration of important forest tree species *(Acacia nilotica, Cedrusdeodara, Dalbergiasisoo, Tectonagrandis, Gmelinaarborea, Shorearobusta, Eucalyptus spps. Bamboo andPinusroxburghii)* .Intermediate treatments.Artificialregeneration. Intensive studies pertaining to important commercial species. Advanced and modern nursery tools &techniques.

**Practical**

Acquaintance with various technical terms of silviculture.Study of forest composition. Recording the observations on shoot development, growth rings ,crown development , leafing, flowring, and fruiting in *(Acacia nilotica, Cedrusdeodara, Dalbergiasisoo, Tectonagrandis, Gmelinaarborea, Shorearobusta, Eucalyptus spps. Bamboo and Pinusroxburghii).*Study of site factors like climatic, edaphic, physiographic and biotic.Study of natural regeneration, Afforestation and Reforestation success. Lay outing of nursery bed for sowing. Classification of world's forest vegetation.

**Suggested Readings**


Dwivedi AP. 1992. *Agroforestry: Principles and Practices.* Oxford and IBH.

Dwivedi AP. 1993. *A Text Book of Silviculture.*International Book Distributors, Dehradun.

Khanna LS. 1996. *Principle and Practice of Silviculture.* International Book Distributors.

Smith DM, Larson Be, Ketty MJ &Ashton PMS. 1997.

Jha, L. K.2014.*Advances in Agroforestry*, Today & Tomorrow's Printers and PublishersNew Delhi.

Lal J.B. 2011.*Forest ecology*,Natraj Publisher Dehradun.

Mishra, S R. 2010.*Textbook of Dendrology*, Today & Tomorrow's Printers and Publishers New Delhi

Patra, A K. 2013.*Agroforestry: Principles and Practices*,Today & Tomorrow's Printers and PublishersNew Delhi.

PradeepKrishan. 2013. *Jungle trees of Cenrtral India.* Penguin Books India.

Smith DM, Larson BC, Ketty MJ, and Ashton PMS.1997.*The Practicves of Silviculture- Applied Forest Ecology*.John Wiley & Sons.




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Raj, Antony Joseph & S B Lal. 2014.*Agroforestry: Theory and Practices*, Today & Tomorrow's Printers and PublishersNew Delhi

## PAPERII. FOREST BIOMETRY, SURVEYING & ENGINEERINGCr.4 (3+1)

### Objective

To develop understanding of students about tree measurements, forest inventory, forest survey and yield concepts.

### Theory

Measurements of tree diameter, girth, height, form Factor.Estimation of volume, quarter girth formula, estimation of tree age, increment, growth and volume table.Yield of individual tree and forest stands.Forest inventory, sampling methods adopted in forestry, random and non random sampling, point and crown sampling method, measurement of stand density. Forest Surveying: methods, Different methods of chain, plane table and compass surveying. Maps and map reading.Basic principles of Forest Engineering, building materials(cement,sand and concrete). Roads-alignment, component, types of roads,Bridges; General principles, objectives, types, simple design and construction of timber and otherbridges.

### Practical

Measurements of height, girth, diameter of trees.Calculations of volume of felled as well as standing trees, Volume table preparation, Application of sampling procedures, Handling of GPS.Use of different methods of surveying chain compass and plain table.

### Suggested Readings

Benu Singh.2011.*A Survey of the Forestry Research*, Vista International Pub,

ChaturvediAN &Khanna LS. 1994. *Forest Mensuration*, International Book Distributor.

Ram Parkash, 2009. *Forest Surveying*.KhannaBandhu.

Harry G. Champion and S.K. Seth.2005. *A Revised Survey of the Forest Types of India*, Natraj Publication,

McGraw-HilI. Simmons CEO 1980.*A Manual of Forest Mensuration*,Bishen Singh Mahender Pal Singh, Dehradun.

Ram Prakash 1983. *Forest engineering*, International book distributors.

Sharpe GW, Hendee CW & Sharpe WE. 1986. *Introduction to Forestry*,McGraw-Hill Publ.

## PAPER III: FOREST MANAGEMENT, REMOTE SENSING & GIS Cr.4 (2+1+1)

### Objective

To provide knowledge to students about forest management through Remote Sensing and GIS technique.



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## Theory

Principles of forest management, Development of forest management in India. Concept of Normality, Normal Forest, Causes of abnormity in forest management Sustainable Forest Management, Rotation: Meaning and types, Increment, Types of increment, Yield: Types of Yield, Yield regulation in regular forest, yield regulation in irregular forest Management. Units: Working circles, felling series, cutting sections, coupes, periodic blocks and felling cycles. Silviculture system: Definition and types, Bamboo forest management and Working Plan prescriptions. Ecosystem management, Site quality, Stand density, Criteria and Indicators.

Remote Sensing definition, scope, source of energy and interaction with forest, EMR Spectrum concept, radiation law, Orbit, Platform and Sensor, Multi-band concept, Satellite system and its use for forest mapping and management. GIS definition, hardware and software used, methods used in forest management, database and modeling concept. Imagery concept its interpretation and map preparation, LiDAR and RADAR concept for forest. Application of RS & GIS for forest management and planning, forest covers type discrimination and change detection analysis.

## Practical

Study of various records and forms maintained in Forest division with regard to management of forests under their control.Study of working plans of the forests.Toposheet reading, determination of scale and height on toposheets, introduction to different GIS software, conversion of file formats, image registration / geocoding, digitization, geo-referencing, Projection, File sub setting, mosaicing, unsupervised and supervised classification of forest, map preparation for forest cover, type, slope, LULC, fire, field visit for ground truthing.

## Suggested Readings


Burrough PA.1990. *Principles of GIS for Land Resources Assessment*, Oxford & IBH Lilesand T.M.

Clarke, Keith. 2011. *Geographical Information System*, Prentice Hall.

Dwivedi A.P. 1993. *A Text Book of Silviculture*, International Book Distributors, Dehradun.

J.B.Lal.2011.*Forest Management: Classical Approach and Current Imperatives*,NatrajPublishers,Dehradun .

Franklin, Steven. 2014. *Remote Sensing for Sustainable Forest management*, CRC Press.

John Wiley.*Remote Sensing and its application.* Universities Press

Kohl, Michael 2012. *Sampling Methods, Remote Sensing and GIS Multisource Forest Inventory*, Springer publication.

Lillesand and Kiefer 2009.*Remote Sensing and Image Interpretation*, VI edition of John Wiley & Sons.

Lecture notes. 2000. *Photogrammetry and Remote Sensing*, module I, IIRS

Sen, Raj Kumar.2012. *Forest Management and Sustainable Development*,Today & Tomorrow's Printers and PublishersNew Delhi.




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## Paper IV. FOREST ECOLOGY AND BIODIVERSITY CONSERVATIONCr.4 (3+1)

### Objective

To develop understanding of students about ecological aspects of forest resource and biodiversity conservation.Consequences of depleting biodiversity and sustainable use of biodiversity: Issues and challenges.

### Theory

Forest ecology, forest community dynamics, forest community structure and function, ecology of forest landscape spatial heterogeneity; Hierarchy issues in ecology. Conservation of natural resources (Hotspot areas, Wildlife Sanctuaries, National parks, Biosphere reserve-terrestrial and aquatic, Botanical Gardens, Zoological Parks), Important Plant and wildlife ecological indicator species, endangered species, Coral reefs, Mangrove forest.Global warming and forests.Green House Effect,Ozone depletion and its consequences.Biodiversity Conservation laws and acts.Forest genetic resources of India.Survey exploration and sampling strategies.Documentation and evaluation of forests genetic resources (FGR), *in situ* and *ex situ* conservation of genetic resources.Biological diversity and its significance to sustainable use.Handling and storage of FGR.Intellectual property rights. Quarantine laws and FGR exchange.

### Practical

Study of forest community structure and its successional status, Estimation of productivity of forest ecosystem, Trip to different regions of the state to study forest vegetation, Collection and preservation of specimen, Identification of ecological indicator species, Methods of vegetation analysis, Measurement of biomass and productivity, Quantification of litter production and decomposition, Visit to National parks, Wildlife sanctuaries, Botanical gardens and arboreta.

### Suggested Readings


Anonymous. 2006. *Report of the National Forest Commission.* Govt. of India.

Kumar Arvind. 2005. *Biodiversity and Conservation*, Today & Tomorrow's Printers and Publishers New Delhi.

Dhyani SN. 1994. *Wildlife Management,* Rawat Publ.

Malik, Ashok. 2008. *Dynamics of Forest Ecosystems*, Today & Tomorrow's Printers and PublishersNew Delhi.

Huxley P. 1999. *Tropical Agroforestry,*Blackwell.

Khan TI &Al-Azmi DN. 1999.*Global Biodiversity Conservation Measures,*Pointer Publ.

Kimmins JP.1976.*Forestry Ecology*, Macmillan.

Nautiyal S &Koul AK. 1999.*Forest Biodiversity and its Conservation Practices in India,* Oriental EnterprisesNew Delhi .

Ramakrishnan PS. 1992.*Shifting Agriculture and Sustainable Development.*Man and




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Biosphere Series,The Parthenon Publ.Group.

Singh, M P et al .2013.*Conservation of Biodiversity and Natural Resources*.Today & Tomorrow's Printers and Publishers New Delhi.

## PAPER V. FOREST PROTECTION Cr.4 (3+1)

### Objective

To provide knowledge to students about forest protection through diseases &pest management.

### Theory

General concept of forest protection. Forest Fire, Wildlife damage in nurseries, plantations and their management. Weed problems in nurseries, plantations and their control. Adverse climatic factors, acid rains and air pollutants in relation to forest tree health.

Disease concept and disease cycle.Biodegradation of wood - microscopic and chemical effects of white rot, brown rot, soft rot and wood discoloration. Heart rots - factors affecting heart rots,damage caused, compartmentalization of decay in trees and management of heart rots. Role of mycorrhiza in tree health. Important diseases of forest trees- Teak, Sal, Shisham, *Acacia, Dalbergia*, Deodar, Pines and Casuarina. Insect pest of Sal, Teak, Shisham, Babool, *Ailanthus*, Pines, Deodar, Casuarinas and *Albizia*. Biological control of insect pests and diseases of forest trees Nature of disease resistance. Molecular tools for developing disease resistance trees.

### Practical

Collection, identification and preservation of important insect pests and disease specimens of forest plants.Preparation of culture media and methods of inoculation. Vegetative and reproductive study of pathogens. Detection of insect infestation and seed borne mycoflora. Assessment of losses due to diseases, insect pests etc. Fire control methods and devices, Familiarization with the meteorological and plant protection equipment, Application of pesticides and bio- control agents in the management of insect pests, weeds, diseases in nurseries and plantations, Extraction of spores of Vascicular arbuscula rmycorrhizal (VAM), fungi from soil and assessment of mycrorrhizal root infection,

### Suggested Readings

Bakshi BK. 1976. *Forest Pathology*.Controller of Publications, GOI.

Jha LK &SenSarna PK. 1994.*Forest Entomology*.Ashish Publ. House.

S SNegi,2006.*Handbook of Forest Protection*. International Book Dist., Reprint

Schmidt, Olaf.2006.*Wood and Tree Fungi: Biology Damage Protection and Use*, Today & Tomorrow's Printers and Publishers,New Delhi.

Paul. D. Mennan. 1991. *Tree Diseases Concept*. Prentice Hall.

Stebbings EP. 1977 .*Indian Forest Insects*.JK Jain Bros.



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## PAPER VI.FOREST STASTISTICS& RESEARCH METHODOLOGYCR.5 (3+1+1)

### Objective

To provide exposure about methods of statistical analysis, design and sampling techniques.

### Theory

Introductory: Statistics scales of measurement, concept of graphical, exploratory and inferential data analysis, important variables of forestry sector. Mean, Median, Mode and SD. Concept of Probability.

Correlation and regression: Simple, Rank, Partial, Multiple, infraclass correlations, Coefficient of determination. Linear and nonlinear regressions. Tests, if significance - t, F, z, and $\chi^2$, testing significance of correlation and regression coefficients, analysis of variance (ANOV A) - one way and two way classification with single: and more than one cell frequency. Design of Experiments. Principles of experimental designs, Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Split Plot and Strip Plot Designs.

### Practical

Fitting of probability distributions, Computation of correlations and regressions, Tests of significance - t, F, z and $\chi^2$, Laying out of designs in the field (i)Latin Square, (ii) Randomized block design, (iii) Split plot design, (iv) Data analysis of the above designs.

### Suggested Readings


Forestry Statistics India-1996 : Indian Council of Forestry Research and Education. 1999

MatinJ. 1976.*Principles of Database Management.*Prentice Hall Pase UG &Sukhatme MU. 1978.

Mead R & Relay J. 1987. *Statistical Tools for Agro-Forestry Research - Bivariate Analysis for intercropping Experiments.* ICRAF, Nairobi.

P.N.Arora. 2003.*Biostatistics*, Himalayan Publishing House.

Surendran C, Sehgal RN &Paramathma M. *Statistical Methods for Agricultural Workers.*ICAR.2003.

*Text Book of Forest Tree Breeding.*ICAR.


## SEMESTER-II

## PAPER I. FOREST POLICY, LAWS AND ENVIRONMENTAL LEGISLATION

### Cr.4 (2+1+1)

### Objective

To develop understanding of students about forest policy, laws and Environmental Legislation.

## Theory

Forest policy- Relevance and scope, National Forest Policy – 1894, 1952 and 1988:General principles of criminal law; Indian Panel Code, criminal procedure code; Forest laws, Indian Forest Act -1927, general provision and detailed study; Forest Conservation Act 1980, Wildlife Protect Act 1972.Important Forest Rules and Guidelines. Forest Right Acts, 2006. Chhattisgarh State Forest Acts and Rules.Important case studies and landmarkjudgments.

## Practical

Visit to High Court, Lower Court. Visit to forest depot. Visit and study about crime cell of forest department

## Suggested Readings


Chaturvedi A.N 2011.*Forest Policy and law,* KhannaBandhu.

*Indian Forest Acts* (with short notes) 1975. Allahabad Law Agency.

Jha LK. 1994. *Analysis and Appraisal of India's Forest Policy.* AshishPub!.House.

Poddar A.K. et al. 2011.*Forest Laws and Plicies in India,* Today and TomarrowPrinters and PublishersNew Delhi

Prabhakar V.K., 2001. *Laws on Forests* ,Anmol Publication.

National Forest Policy 1952.Ministry of Food and Agriculture, New Delhi.

National Forest Policy 1988.Ministry of Environment and Forests, New Delhi.

Saharia, VB. 1989. *Wildlife Law in India.*Natraj Publ.

SairamBhat 2010. Natural Resources Conservation Law, Sage.

Negi SS. 1985. *Forest Law.*Natraj Publ.


## PAPER II.FOREST TREE IMPROVEMENT AND BIOTECHNOLOGYCR.4 (3+1)

## Objective

To acquaint the students about general principles of tree breeding with examples ofimportant trees.

## Theory

General concept of forest tree breeding, tree improvement and forest genetics.Reproduction in forest trees, dimorphism pollination mechanisms. Pollen dispersion distances, pollinators and their energetics. Attractants for pollinators. Pollen handling forced flowering for seed orchard manipulation. Pollination mechanisms. A Variation in trees importance and its causes. Natural variation as a basis for tree improvement.Geographic variations - Ecotypes, clines, races and land races.Seed, seed formation, dispersal, storage, stratification and seed dormancy.Selective breeding methods- mass, family, within



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family, family plus within family. Plus tree selection for wood quality. Progeny and clone testing.Seed orchards - type, functions and importance.Estimating genetic parameters and genetic gain.Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis.Species and racial hybridization. Indian examples - Teak, Sal, Shisham, *Eucalypts, Acacias,* Pines And Poplars.Polyploidy, aneuploidy and haploidy in soft and hardwood species.Induction of polyploidy.Hardy-weinberg law, null hypothesis, Wohlund's Principle.

Biotechnology in tree improvement Mutation breeding. Tissue Culture, Micro-propagation, Genetic engineering, Transgenic plants, Molecular marker and its application in forestry.

**Practical**

Floral biology, modes of reproduction and modes of pollination in forest trees.Estimating pollen viability.Controlled pollination and pollen handling.Manipulation of floweringthrough hormones.Identification of ecotypes, races, and land-races in natural forest. Visit to species, provenance and progeny trials. Selection of superior phenotypes.Marking of candidate trees, plus trees and elite trees. Visit to seed orchards. Comparison of parents and their putative hybrids.Induction of polyploidy through colchicines treatment.

**Suggested Readings**

Khan IM. 2014 Forest Biotechnology, Today and Tomorrow Printers and PublishersNew Delhi.

MandaiAK &Gibson GL. (Eds). 1997. *Forest Genetics and Tree Breeding.* CBS.

Surendran C, Sehgal RN &Paramathma M. 2003.*Text Book of Forest Tree Breeding.* ICAR Publ.

P. Shanmughavel, 2004.*Tree Improvement and Biotechnology*, Pointer.

Russel Haines, 1996. *Biotechnology in Forest Tree Improvement with Special Reference to Developing Countries,*. Reprint, Dehradun.

White J.W. 1976. *Introduction to Forest Genetics.* Academic Press.

Zobel BJ &Talber J. 1984.*Applied Forest Tree Improvement.*John Wiley &Sons.

**PAPER III.WOOD TECHNOLOGY AND NANO FORESTRYCR.4 (3+1)**

**Objective**

To acquaint with the physical characteristics and strength properties of wood.

**Theory**

Wood as a raw material, kinds of wood : hard wood, soft wood, bamboos and canes. Merit and demerits of wood as a raw material. The physical features of wood. Mechanical properties of wood- tension, compression, bending, shearing, cleavage, hardness, impact resistance, nail and screw holding capacity.



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Suitability of wood for various uses based on mechanical and physical properties. Electrical and acoustic properties of wood.Wood water relationship- shrinkage, swelling, movement, fiber saturation, equilibrium, moisture content. Wood seasoning, principles and types- air seasoning, kiln seasoning &chemical seasoning. Refractory classes of timber, kiln schedule.Seasoning defects and their controls. Wood preservation- needs, principles, process, types of wood preservatives (water soluble, oil based, etc ). Classification of timbers based on durability. Methods of preservation. Pressure methods- full cell process, empty cell process. Wood machining: Sawing – techniques, kinds of saws – cross cut edging, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.Nanotechnology potential in forest product industry, Nano cellulose technology.Basic concepts of Nano forestry, tools techniques and significance.

## Practical

Determination of wood density, study of thermal, electrical and acoustic properties ofwood.Determination of tensile and bending properties of wood.Determination of moisture content and swelling coefficients of different woods. Comparative studies on air and kiln dried woods. Analysis of decayed wood for physical and chemical parameters.Treatment of wood with different types of preservatives.

## Suggested Readings


Chauhan Luxmi and R. Vijendra Rao, 2003.*Wood Anatomy of Legumes of India: Their Identification, Properties and Uses*, BSMPS.

Hill, Callum A S. 2006. *Wood Modification*: *Chemical Thermal and Other Processes,* Today & Tomorrow's Printers and Publishers New Delhi.

Mehta T.1981. *A handbook of Forest Utilization*.Periodical Expert Book Agency.

Printers and Publishers New Delhi 2006.

Rao KR &Junaja KBS. 1992. *Field Identification of 50 Important Timbers of India.* ICFRE, Dehradun.

Schmidt, Olaf. *Wood and Tree Fungi: Biology Damage Protection and Use*, Today & Tomorrow's Printers and Publishers New Delhi.

Sharma LC. 1977. *Development of Forests and Forest-based Industries.* Bishen Singh MahenderPal Singh, Dehradun.

Terry Porter. 2006. *Wood: Identification and Use*,Guild of Master Craftsman Pub.

Trotter H., 1982.*Manual of Indian Forest Utilization*.FRI&College, Dehradun.

Wadoo MS. 1992. *Utilization of Forest Resources*.IDRIS Publ.

Negi S.S. 1997. *Wood Science and Technology*,International Book Dist.




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## PAPER IV.WILDLIFE BIOLOGY AND CONSERVATIONCR.4 (3+1)

### Theory

Introduction/Conservation ethics- Definitions, Values, Zoological classification, Sign and symptoms.Animals behavior & adaptations, Wild life Ecology, Basic concepts, Wildlife habits and habitat. Wildlife Ecology: Wildlife habitat and component Wildlife conservation: Definition, Concept, significance. Wildlife conservation movement, Wildlife conservation in India, In-situ and Ex-situ wildlife conservation, Role of protected area in wildlife conservation, some rare and threatened wildlife species of world particularly India, special project for endangered species, Project tiger, GirLion Project, Crocodile Breeding Project, Wildlife Conservation organization- National and International.

Wild life management: Wild life management its scope as a natural resource, current status of wildlife management. Management of certain animals: small game management water fowl, Pigeon, aquatic animal. Reptile, Big game management, Tiger, Bear, Elephant, Rhinoceros, deer. Biological basis of management- animal population, shelter, food, WL Policy Legislation and administration policies and programmes, Wild life protection act 1972, wild life education, Age and Sex determination, Tiger census, Preservation of biological material, National Park and Sanctuaries of (C.G). Biotelemetry, Forensic Analysis.

### Practical

Study of mammals birds and animals in university premises, Identification of pugmark, evaluation of Roosting cover in university premises, Plotting of National Park and Sanctuaries.

### Suggested Readings


Agarwal, K.G.,2000.*Wildlife of India: Conservation and management*, Nidi Publishers India.

GopalRajesh.,1993. *Fundamentals of wildlife management*, Justice Home Publication, Allahabad.

Hosetti B.B, 1997. *Concept of Wildlife management*, Daya Publishing House, Delhi.

James, *A.* 1984 *Principles of wildlife management*, Inc. Bailey, John Wiley & Sons,New York.

Hunter, M.L. Jr., 1990.*Wildlife forest and forestry principals of manageing forest for Biological diversity*.,Printice Hall,.

Singh, S K.,2009. *Textbook of Wildlife Management*, Today & Tomorrow's Printers and Publishers New Delhi.

Stephen H, Berwick and V.B, Sharia, 1995.Wildlife *Research and management*, Oxford University Press, Oxford,.




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## PAPER V. FOREST SOILS AND WATERSHED MANAGEMENTCR.4 (3+1)

### Theory

Definition and importance of forest soils; Origin, classification and nomenclature of soils; Soil profile; Soils of major forest biomes; Difference between forest soil and other arable soils; Important physical, chemical, and biological properties of forest soils; Forest soil survey; land use type and forest plantations; Forest-soil types; Silviculture practices and forest soils.

Organic matter content, litter decomposition and C:N ratio in forest soil; Forest soil fertility, nutrient management and biological nitrogen fixation; Management of forest nursery soil.

Soil degradation-problems and impact on forest ecosystems; Forest fire and soil resilience; Forest soil pollution, Characteristics, ecology and management of tropical forest soils.Problems and prospects in management of tropical dry and moistdeciduous forest soils.

Watershed management concept, Problems of land degradation, Soil and water conservation measures for arable and non-arable lands, Storage and recycling of water, Criteria for watershed size determination.

Watershed work plan for degraded sites.Rehabilitation of degraded lands and prevention of natural hazards.

### Practical

Determination of soil moisture, texture, porosity, bulk density, particle density and water holding capacity; Determination of pH, EC, organic C & N,Study of forest soil profile in field, Studies on nitrogen fixing and phosphorous absorbing microbes; Studies on fertilizers, biofertilizres and FYM uses in forest nursery, visitsto nearby forest nursery and watershed areas.

### Suggested Readings:


A K Mani; R Santhi and K M Sellamuthu, 2008.*Fundamentals of Forest Soils*, Satish Serial Pub.

DhuruvaNarayana, V.V., Sastry, G. and Patnaik, V.S. 1990. *Watershed management.*ICAR Publication, New Delhi.

Murty, J.V.S.1995. *Watershed management in India.* Wiley Eastern, New Delhi.

Singh, P.K. 2000.*Watershed management: Design and Practices.* E-media publications,Udaipur, India.

N.C. Brady 1990.*The Nature and Properties of Soils*: MacmillanPublishing Company, New York (10th Edition).

Negi S.S., 2000. *Forest Soils*, International Book Distributors, .

Osman, Khan Towhid, 2013. *Forest Soils: Properties and Management*, Springer Science publ.

R.F. Fischer and D. Binkley (2000).*Ecology and Management of Forest Soils*

S.A: Wilde 1995.*Forest Soils and Forest Growth, Periodicals* Express Book Agency, New Delhi,International Book Distributors, Dehradun.




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## PAPER VI. FOREST PRODUCTS AND INDUSTRIESCR.4 (3+1)

### Objective

The course will equip the students regarding wood based industries. How it is affecting the economy of the country such as match and splint, sports and pencil making, besides this wood extracts resins and gums, katha, tannis and various type of non timber products. Practical will make them aware regarding extracting method of different products of wood.

### Theory

Importance of forest based industries in relation to Indian economy. Chemistry in relation to forest products.

Description of different forest based industries - paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes.

Cell wall constituents.Chemistry of cellulose, starch, hemicelluloses and lignin. Extraneous components of wood - water and organic solvent soluble.

Taping of oleoresin from major pine species. Types of the gums and their extractions [arabic, ghatti and tragacanth).

Recovery and uses of volatile oils, tannins, katha and cutch. Nature and uses of important forest based dyes and pigments.

### Practical

Estimation of cell wall contents -- Hemicellulose and lignin, Extraction of essential oils, resins, tannins and gum, Characterization of pulp & rate of pulping, Identification and properties of wood and non wood products used for forest based industries. Visit to nearby forest based industries.

### Suggested Readings


Anonymous. 1981. *Wealth of India* CSIR.

Anonymous. 2007. *Year Book: of Forest Products.* FAO

Dwivedi AP. 1993. *Forestry in India.* Surya Publ.

Krishnamurthy T. *Minor Forest Products of India.* Oxford &IBH.

Mehta T. 1981. *A Handbook of Forest Utilization.* Periodical Expert Book Agency.New Delhi.

Praveen Taank, 2010. *Forest Product and their Utilization.* Cyber Tech , .

Shiva., M.P., 1998., *Timber Forest Products and Shrub and Herb Species of NTFP Importance* : , Indus, .

T. Krishna Murthy. 2010. *Minor Forest Products of India : Non-Timber Forest Products of India* : BS Pub, Second Edition.

Tewari, D. D., 2008. *Management of Non-Timber Forest Product Resources of India*:An Analysis of Forest Development Corporations. Lucknow: International Book Distributing Company, Lucknow.

Troup, R S.,2007. *Manual of Indian Forest Utilisation* Today & Tomorrow's Printers and Publishers




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## PAPER VII: ENVIRONMENT AND GLOBAL CLIMATIC CHANGES
**CR.4 (3+1)**

### Objective

To develop understanding of students about environmental and climatic System. To develop understanding of students about global climatic changes and their effect on forest aquatic ecosystems.

### Theory

Environment: Definitions and concepts of environment components of atmosphere, hydrosphere, pedosphere, biosphere and their interactions. Biogeochemical cycle of green house gases, source and sinks.

Environment Pollution : Types of pollutions, methods of measurement of pollution, classification of pollutants, national and international Environmental standards of important pollutants.

Air pollution : Major pollutants and their sources. Ionizing radiation, monitoring of gaseous pollutants and particulate matter, Vehicular pollution.Biological abatement of air pollution.Development of green belt.

Water Pollution : Important pollutants source, impact of heavy metals, halogen and radio nuclides on aquatic flora and fauna. Treatment technologies for industrial effluents/wastewater.Monitoring water pollution and water quality standards.

Soil pollution : Heavy metal toxicity in soil, Impact of pesticides, industrial waste and fertilizers on soil physicochemical properties. Microbiological degradation of xenobiotics in environment.

Climate changes: Earths climate systems, adaptability and vulnerability. A global perspective of climate change, global warming, green house gases, IPCC initiatives in climate change mitigation, various mitigation mechanism- Kyoto protocol- strategies. Impact of climate changes on Indian forest, adaptation of forest trees to climate change, case studies on the management of certain tree species in India.

Global Environmental Problems : acid rain, Eutrophication, Biomanipulation, Ozone depletion and UV radiation. Bioremediation of contaminated soils and waste lands.Environment Impact Assessment.

### Practical

Impact of particulate matter on environment, Impact of coal mining on environment Impact of cement pollution in environment.Effect of effluent from several industries on environment.Reclamation of mining wastes with microorganisms. Bio-accumulation studies on metals by microorganisms.Assesment of environmental impact on polluted sites.Assessing the awareness of environmental regulation and control methods,Impact of power stations on plant, microorganisms, animals and soils ecosystems, EIA of polluted river ecosystem, Environmental Impact Assessment.

### Suggested Readings

Anonymous . 2006. *Report of the National Forest Commission.* Govt.of India, New Delhi.

E. Claussen, V. A. Cochran, and D. P. Davis. 2001. *Climate Change: Science, Strategies, & Solutions*, University of Michigan.



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Huxley P. 1999. *Tropical Agroforestry.* Blackwell Science.

Koskela J, Buck A & Teissier du Cros E. 2007. *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe.* Biodiversity International; Rome, Italy.

*Strategies and Solutions.* Pew Centre on Global Climate Change, USA.

Streck, C et al, 2006 Climate Change and Forests Emerging Policy and Market Opportunities Today & Tomorrow's Printers and Publishers New Delhi.

# SEMESTER- III

**SPECIALIZATION COURSES**

Following two specialization courses will be offered to the students and students have to select only one specialization courses during the semester.

**A. FOREST GENETIC RESOURCES**
**B. FOREST MANAGEMENT**

## A. FOREST GENETIC RESOURCES

### PAPER I. BREEDING METHODS IN FOREST TREESCr.4 (3+1)

**Objective**

To acquaint the students about the concepts of sub- selection, population structure for breeding and production, genetic testing and making designs.

**Theory**

Genetic constitution of tree populations, half-sib, full-sib family in trees. Hardy- Weinberg equilibrium, changes in gene frequency through selection, migration, mutation and population sizes.

Long-term and short-term breeding populations. Selective breeding methods- mass, family, within family, family plus within family. Grading system of plus trees in natural stands and plantations regression systems, mother tree selection, subjective evaluation. Selection for different traits.

Genetic testing programs - mating designs, complete designs - nested designs, factorial, single pair mating, full diallel, half diallel and partial diallel, incomplete pedigree designs - open pollinated mating and polycross mating.

Experimental designs in genetic testing. Selection for disease resistance, tolerance to herbicide, salt, metals, high and low temperature, water stress. Marker assisted selection. Breeding methods for wood quality, agroforestry, diseases and pest resistance, drought and



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salt resistance.

Tree improvement case histories. Calculating gene and genotype frequencies.Flow chart for different breeding methods.

**Practical**

Half-sib, full-sib family in trees.Grading system of plus trees in natural stands. Mating designs, complete designs - nested designs, factorial, single pair mating, full diallel, half diallel and partial diallel, incomplete pedigree designs - open pollinated mating and polycross mating. Selection for biotic and biotic stresses.

**Suggested Readings**


*Breeding.*ICAR.

FAO. 1985. *Forest Tree Improvement,* FAO Publ,

Faulkner R. 1975. *Seed Orchard* Forestry Commission Bull. No.34.

Fins L, Friedman ST & Brotschol JV.1992. *.Handbook of Quantitative Forest Genetics.* Kluwer.

Khosla PK. *1981. Advances in Forest Genetics.* Ambika Publ., New Delhi.

Mandal AK &Gibson GL(Eds.). 1997, *Forest Genetics and Tree Breeding.* CBS.

Namkoong, Gene, Kang, Hyun C., Brouard, Jeans S. Tree Breeding: Principles and strategies, Academic Press.

Steve Lee and John Woolliams. 2013. *Novel Tree Breeding.* Publinia@inia.es

Wright JW. *1976. Introduction to Forest Genetics*, Academics Press.

Yanchuk, A.K. 2009.*Forest and forest plants*- Vol. III. Techniques in forest tree breeding.

Zobel BJ Talbert J. 1984. *Applied Forest Tree Improvement.* John Wiley & Sons.

Zobel BJ, Wyk GV &Stahl P. 1987. *Growing Exotic Forests.*John Wiley & Sons.


## PAPER II.FOREST TREES REPRODUCTIVE BIOLOGY ANDSEEDORCHARDS CR.4 (3+1)

**Objective**

To impart the knowledge of reproduction in forest tree species and to understand the mechanism of breeding, sex expression, and seed orchard development

**Theory**

Importance and application of reproductive biology in tree breeding.Modes of reproduction: vegetative, asexual, sexual reproduction their breeding systems and sex expression. Monoecy, dioecy and its evolution. Out-crossing mechanism in forest trees. Environmental effects on sex expression. Floral biology. Initiation and development- Microsporogenesis, Megasporogenesis, modes of pollination; Self



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and out-crossing.Fertilization in hardwood and softwood species.Embryo development, seed development, Seed dispersal and gene flow.Seed orchard need, establishment of seed orchard , hybrid and research seed orchard, selection and preparation of seed orchard site, isolation, orchard size, orchard design.Seed orchards – production and management, different types of seed orchards – SSO and CSO-merits and demerits.Progeny testing and its importance.Pests and disease management.Importance of seed orchards in gene conservation.Seed production area- its production and management.

### Practical

Sex expression in forest trees.Out crossing mechanisms in forest trees.Measurement of pollen flow in wind-pollinated and insect-pollinated species.Pollen viability and fertility. Seed dispersal mechanism. Visit and study of seed orchard design. Plant growth regulator application for flower induction. Study the Intraclonal variation in floral and seed characters

### Suggested Readings


*FAO.*1985. *Forest Tree Improvement,* FAO Publ.

Faulkner R. 1975. *Seed Orchard* Forestry Commission Bull.No.34.

Fins L, Friedman ST &BrotschollV. 1992. *Handbook of Quantitative Forest Genetics.*

Khosla PK. 1981. *Advances in Forest Genetics.*Arnbika Publ., New Delhi.

Khrwer.

Mandal AK &Gibson GL.1997. *Forest Genetics and Tree Breeding.* CBS.

Shivana H. 2012 . *Handbook of forest Biology.* Today's and Tomorrow printers and publisher, New Delhi.

Surendraran C, Sehgal RN &Parmathama M. 2003. *A Text Book of Forest Tree Breeding.* ICAR.

Wright JW. 1976. *Introduction toForest Genetics.* Academic Press.

Zobet BJ &Talbert J. 1984. *Applied Forest Tree Improvement.*John Wiley & Sons.

Zobel BJ, Wyk GV & Stahl P. 1987. *Growing Exotic Forests.* John Wiley & Sons.


## PAPER III.MOLECULAR GENETICS OF FOREST TREES CR.4 (3+1)

### Theory

Genome: Nuclear Genome, Mitochondria Genome, Chloroplast Genome and Evolution of the three Plant Genomes. Transcription and translation of forest tree Genes. DNA replication.Genetic code.Gene expression.Regulation of Gene Expression.DNA damage, repair and recombination.

Genetic diversity/Genetic variation of forest trees: causes and advantages. Genetic characterization of forest tree species.Morphological, Biochemical and Genetic markers. Molecular markers: Dominant and codominant, Types of molecular markers: advantages and disadvantages. Techniques in molecular



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genetics of forest trees: DNA isolation, DNA quantification, DNA restriction; Primer ,gel electrophoresis; southern, northern and western blotting; nucleic acid hybridization; polymerase chain reaction, gene sequencing .

Polymorphism and its significance.Calculation of genetic diversity within and between forest tree populations.Molecular markers and genome mapping.Application of molecular markers in forest tree improvement.Genomics of wood formation.Molecular genetics of cellulose biosynthesis.

Associate mapping through molecular markers.Social issues in molecular genetics.Bioinformatics.

**Practical**

Estimation of genetic diversity between/among forest tree populations through Morphological markers.Preparation of solutions for DNA isolation, Electrophorisis and PCR Standardization of protocols for DNA isolation of different forest tree species. Standardization of working protocol for RAPD,ISSR and AFLP analysis Estimation of genetic diversity between/within forest tree population through molecular markers.

**Suggested Readings**


American Soc. Of Plant Physiologists, Maryland, USA Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA

Bob B. BauchnanWilhemGruissem and Russel L. Jones. 2002. Biochemistry & Molecular Biology of plants. Wiley CDA

Brow T.A2007 Genomes – 3 – Garland Science House, New York.

Buchanan, BB, W Gruissem, RL Jones. 2000. Biochemistry and Molecular Biology of Plants.

David Freifelder 1996. Essentials of Molecular Biology, Panima Publishing Company,New Delhi.

Douglas S. Falconer, Trudy F.C. Mackay 2012. *Introduction to Quantitative Genetics.* Darling Kindersley, India Pvt Ltd.

Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick . 2012 GENES XI 11 th Edition. Jones and Bartlett Publisher.

John Wiley & Sons, Somerset NJ Alberts, B.Bray, D Lewis, J., Raff, M., Roberts, K and Walter1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.

Kole, Chittaranjan 2013. *Forest Trees: Genome Mapping and Molecular Breeding in Plants.*, Today & Tomorrow's Printers and Publishers New Delhi

Lewin B.2000. Genes VII. Oxford University Press, New York.

Schnell, R J et al 2012. *Genomics of Tree Crops.*Today & Tomorrow's Printers and Publishers New Delhi.




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S.M.Jain and S.C. Minocha. 2002. Molecular Biology of Woody Plants. KulwerAcedemic Publisher, London.

Sandeepkumar,Mathias Fladung.2003. Molecular genetics and Breeding of forest trees.Food product press.An imprint of Hawarth press.Inc New York.London.Oxford.

## PAPER IV: QUANTITATIVE GENETICS OF FOREST TREES CR 4(3+1)

### Objective

Toimpart knowledge in the field of biometry as applied to breeding, population, provinces and making experience in forest genetics and tree breeding.

### Theory

Historical aspects of quantitative genetics; multiple-factor-hypothesis.Population structure, mating systems.

Hardy- Weinberg equilibrium: properties and implications of equilibrium, influence ofmutation. migration and selection. Random mating consequences in small populations.Random drift, inbreeding coefficient, rate of inbreeding.

In breeding in pedigreed population, inbreeding coefficient under regular systems of inbreeding. Statistical parameters used in studying polygenic traits.

Testing and estimating: population mean and components of phenotypic value, breeding value, dominance, interaction and environment deviation. Models of gene action, significance of different genetic components, G x E component of variance.

Estimation of genetic components of variance through resemblance of relatives.Fisher's. fundamental theorem on natural selection and its implications. Heritability-its estimation and significance.

Selection theory for a quantitative character. Prediction of selection response: patterns, asymmetry, and causes. Selection criteria and use of information from relatives. Correlation among characters, correlation response and indirect selection.

Effect of inbreeding on mean and variance.Heterosis and causes for heterosis in FI and later generations.Combining ability effects, variances and selection for combining ability. Threshold characters.

### Practical

Quantitative and qualitative character analysis in forest tree species.Phenotypic, genotypic correlations and path analysis of forest trees.Estimation of variance components from analyses of variance using



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various mating designs of forest trees. Estimation of population value with respect to quantitative/qualitative traits.Multivariate analysis.

**Suggested Readings**


FAO.1985. *Forest Tree Improvement,* FAO Publi.

Faulkner R. 1975. *Seed Orchard.* Forestry Commission Bull. No.34.

Fins L, Friedman ST & Brotschol JY. 1992. *Handbook of Quantitative Forest Genetics.* Kluwer.

Khosla PK. 1981. *Advances in Forest Genetics.* Arnbika Publ., New Delhi.

MandaiAK& Gibson GL. (Eds.). 1997. *Forest Genetics and Tree Breeding.* CBS.

Phundan Singh. 2012 Objectives of quantitative genetics.Ludhiana Kalyani Publishers.

R.K singh and B.D. Chaudhary.2012 Biometrical Methods in Quantitative Genetics Analysis. Kalyani Publishers.

Surendran C, Sehgal RN &Parmathama M. (Eds.). 2003. *A Text Book of Forest Tree Breeding.* ICAR.

Thirugnna Kumar. 2012 Objectives Genetics and Crop Breeding.New India Publishing Agency.

White, TL,Adams , WT and D.B. Neal. 2007 Forest Genetics.CABI Publishing, UK.

Wright JW. 1976. *Introduction to Forest Genetics.* Academic Press.

Zobel BJ &Talbert J. 1984.*Applied Forest Tree Improvement.*John Wiley &Sons.

Zobel BJ, Wyk GY &Stahl P. 1987. *Growing Exotic Forests.*John Wiley &Sons.


## PAPER V: FOREST GENETIC DIVERSITY, CONSERVATION & ENVIRONMENTAL IMPACT CR 4(3+1)

**Objective**

To provide the students knowledge about the genetic diversity in forest tree species, their distribution, assess and analysis law and methodology of *in-situ* and *ex-situ* conservation.

Forest biodiversity: concept, levels and measurement. Forest genetic diversity: Values, Services and threats.Levels of Genetic Variation in Forest Trees.Characteristics of Forest Genetic Diversity: Interspecific and Intraspecific diversity, Ecotypes, Subspecies, Population, Metapopulation, Provenance, Land race, Cline. Dynamics of forest genetic diversity: Genetic erosion, Population bottleneck, Genetic drift, Selection, Migration and Mutation.Genetic diversity in natural forests.Natural and induced genetic diversity in forest tree species.Biodiversity in forests of India (Tropical and Temperate Forests).Hotspots of forest genetic diversity Measurement of forest genetic diversity and diversity indices.Monitoring of forest genetic diversity: Documentation and evaluation.Climate change and forest genetic diversity.

Conservation Of Forest Genetic Diversity: *in situ*and *circa situm*conservation; Protected areas, Biosphere reserves, National parks, Santuaries, gene reserve forest and Community reserves . *Ex Situ* Conservation: gene banks, Cryopreservation. Targeted Species-Based Approach.Intellectual property rights. The Biological Diversity Act, 2002, Quarantine laws and FGR exchange. Conservation efforts in India and worldwide.International conservation bodies: FAO, IUFRO, CIFOR, IUCN and WWF.

**Practical**

Visits and survey of forests biodiversity within their natural habitat.Measurement of forest biological diversity. FGR analysis of Natural stands in nearby forest area.

**Suggested Readings**


1.

FAO. 1985. *Forest Tree Improvement,* FAO Publ.

Faulkner R. 1975. *Seed Orchard* Forestry Commission Bull.No.34.

Fins L, Friedman ST & Brotschol JV. 1992. *Handbook of Quantitative Forest Genetics.* Kluwer.

Fred W. Allendorf, Gordon H. Luikart, Sally N. Aitken. 2012. *Conservation and the Genetics of Population*, 2nd Edition ISBN: 978-1- 118- 40857-5, Wiley E-Book.

Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Publ., New Delhi.

Mahmut Caliskan. 2012 .*Genentics Diviersity in Plants*. In Tech Publishers.

Mahmut Caliskan. 2012. *The Molecular Basis of Plants Genetics Diversity*. In Tech Publishers

Mandal AK & Gibson GL. (Eds.). 1997. *Forest Genetics and Tree Breeding*. CBS.

Padmini Sudarsana, Madhugiri Nageswara-Rao and Jaya R. Soneji.2012. *Tropical Forest*. A free online edition of this book is available at *www.intechopen.com*

Surendran C, Sehgal RN & Parmathama M. (Eds.). 2003. A *Text Book of Forest Tree Breeding*. ICAR.

Wright JW. 1976. *Introduction to Forest Genetics*. Academic Press.

Zobel BJ & Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.

Zobel BJ, Wyk GV & Stahl P. 1987. *Growing Exotic Forests*. John Wiley & Sons.


## SEMESTER- IV

This semester will have following training programmes.

1. **Field Training ( Attachment with State Forest Department for analysis of FGR & its distribution)**
   **Specialization: Forest Genetic Resources (FGR)**

Learn to make FGR Inventory. Analysis of Provenance Variation. Identification of self and cross pollinating forest trees and its genetic diversity pattern analysis. Genetic diversity status on the basis of morphological markers. Population wise conservation priority zones of specific forest tree species.. Species wise adaptability in the natural forest stands. Identification of plus tree and elite tree zones in forest. Flowering and seeding pattern of forest. Seed dispersal pattern and its influence on forest genetic resources. Identification of species wise seed production areas. Clone, seed, pollen and specimen collection. Identifying the factors which are threat to forest genetic diversity. Characterization of Genetic Potential against changing climate. Forest regeneration status. Making plans for longterm and short term tree improvement programmes. Development of practical step guide to the in-situ conservation of FGR. Forest genetic resource management by forest department.

### 2. Industrial Training

Study the nature structure of Industrial Training and Business Organization: Raw material procurement and processing; Production, Marketing and Economics at Wood workshop and saw mills/wood seasoning and preservation treatment units/Pulp and Paper Industries/ Katha making industry/ Resin, Turpentine, Gums, Tendupatta, Chironji Industry; Herbal Pharmacies and other wood product industries.

### 3. Computational skills.

Introduction to computers and personal computers. basic concepts (H/W, S/W, Input & Output Devices) operating system(Introductionof open source and closed source), DOS and Windows XP/7/8, introduction of programming languages, BASIC languages concepts basic and programming techniques, MS Office. Win Word, Excel, Power Point, MS Access.Introduction of Statistical & Remote sensing softwares.Introduction to Multi-Media and its application.Introduction to Internet.

### 4. Student Report

## B.FOREST MANAGEMENT

### PAPER I. FOREST RESOURCE ANALYSIS CR.4 (3+1)

**Objective**

To develop understanding of students about the nature and importance of forest resources, their availability and management strategies.

**Theory**

Forest resources: wood produce and non-wood produce. Raw materials of forest origin for industries viz: paper and pulp; plywood and board, saw mills, furniture making, packing



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case, match splints, toys etc.

Minor forest products: edible products, fodder trees, shrub and grasses. bamboo and cane, medicinal and aromatic plants, oil seeds, gum & resins, fiber and flosses, spices and miscellaneous products e.g. Katha, latex, insecticides, soap nuts, etc.

Animal products from forest - lac, honey, silk, fur, skins, tusks etc. Dependency of villagers/ tribal on forest resources for different livelihood options.

Nature, scope and importance of forest resources in regional & national economy, nature, role and functions of forest based industries, reasons for resource degradation. Causes of low productivity of forest resources, remedial strategies, Trends in the production of important forest resources (wood and non-wood products). Government policies on forest resources.

Approaches to achievements under five year plans. Management strategies for improved production and consumption of forest resources.

**Practical**

Identification, nature and properties of different wood and non-wood forest resources. Techniques& methods of value addition to forest resources for other upgradation. Exercise for forest resource mapping and analysis.

**Suggested Readings**


*Agricultural Production and Resource Use.* Oxford Univ. Press.

Bamoul W J & Oates WE. 1975. *The Theory of Environmental Policy.*

FAO 1986.*Guidelines to Project Evaluation.*Natraj Publ.

FAO.1981. *Tropical Forest Resources Assessment Project* (In the Framework of Gems).*Forest Resources of Tropical Africa.*Part I& II. *Regional Synthesis.*

Kerr JM, Marothia DK, Singh K, Ramaswamy C & Bentley WR. 1997. *Natural Resource Economis- Theory and Application in India.* Oxford &IBH.

Makchau JP &Malcolm LR. 1986. *Economics of Tropical Farm Management.* Cambridge Univ. Press.NautiyalJc.1988 .New Delhi 2007

Prentice Hall. Busby RJN. 1981. *Investment Appraisal in Forestry.* Forestry Commision Research Station, Surveys.

Rakshit, Swapan KumarForest Resource Management/ Today & Tomorrow's Printers and Publishers

Sharma LC, 1980. *Forest Economics - Principles and Applications.*NatrajPubl..

Tewari, D D. 2008 Management of Non Timber Forest Product Resources of India: An Analysis of Forest Development Corporations

Upton M *Forest Economics - Principles and Applications.*NatrajPubl.. 1976.




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## PAPER II. PRODUCTION MANAGEMENT IN NURSERY AND PLANTATION FORESTRY CR.4 (3+1)

**Objective**

To develop understanding and management skills of the students in respect of commercial nursery production and plantation forestry.

**Theory**

Introduction to production theory, Production concepts, Resource-Product Relationship, Types and Kinds of Production Functions, Principles of resource allocation in nursery production, Resource combination and cost minimization: Resource allocation and enterprise combination.Derivation of cost andsupply functions from production functions, Managing risk and uncertainty in nursery and plantation forestry.

Planning and budgeting techniques applied in nursery production and plantation forestry. Record book keeping system. Income and cash flow analysis.Principles of financial analysis, Investment analysis in plantation forestry, Determination of optimum rotation period.

Market structure, Functions, Channels, Marketing efficiency and marketing problems of nursery and plantation forestry.

**Practical**

Exercises on marginal analysis in nursery production, Exercises on investment analysis. Exercises on marketing channels, costs, margin and price spread for different nursery and plantation crops.

**Suggested Readings.**


Busby RJN.1981.*Investment Appraisal in Forestry.* Forestry Commision Research Station, Surveys.

FAO 1986.*Guidelines to Project Evaluation.*Natraj Publ.

FAO. 1981. Tropical Forest Resources Assessment Project (The Framework of Gems). *Forest Resources of Tropical Africa.*Part 1 &ll. *Regional Synthesis.*

Makchau JP Makeham and L.R. Malcolm,Economy of Tropical Farm Management/ Cambride University Press.

Nautiyal JC. 1988. *Forest Economics - Principles and Applications.* Natraj Publ.

Ransit swapan Kumar. 2007. *Forest Resource Managemen.,* Todays and Tomarrow printers and publishers New. Delhi.

Sharma LC. 1980. *Forest Economics - Principles and Applications.* Natraj Publ.

*Natural Resource Economis- Theory and Application in India.* Oxford &IBH.

Makchau JP & Malcolm LR. 1986. *Economics of Tropical Farm Management.* Cambridge *Univ. Press.*

## PAPER III. FINANCE AND MARKETING MANAGEMENT OF FOREST RESOURCESCR.4 (3+1)

### Objective

To develop understanding of students about financial and marketing management tools as applied in forest resources.

### Theory

Finance- definition, aims and objective; Goals of financial management, organization of finance in business firms; Working capital management; need, concepts and sources of working capital.Gross and net working capital; factors influencing working capital requirements.Importance and preparation of Financial Statements, Balance Sheet and Profit and Loss accounts. Sources of long term finance. Purpose and essentials of budgeting, important components of budget, preparation of budgets.

Market-concept, components and classification. Demand and supply and factors affecting the market. Simple market model and price determination. Market structure, conduct and performance. Market integration-meaning, types and effects of market integration.Marketing cost, margin and price spread-concepts and applications. Marketing efficiency- definition. IPRs and their implications in forestry.Marketing of wood andnon-wood forest products.

### Practical

Library review of studies in marketing and trade of national and international timber and non timber forest products. Analysis of price and market data of forestry products.Exercises on analysis of demand and supply of important forest products. Exercises on marketing channels, costs, margins and price - spread of important forest products.Case studies based on visits to selected markets, marketing institutions and forest based industries.

### Suggested Readings


Busby RJN. 1981. *Investment Appraisal in Forestry.* Forestry Commission Research Station, Surveys.

FAO 1986.*Guidelines to Project Evaluation.*NatrajPubl.

FAO, 1981.Tropical Forest Resources Assessment Project(In the Framework of Gems). *Forest Resources of Tropical Africa.*Part 1 & 2*RegionalSynthesis.*

Grebnar D. Betthing P. Siryj .,2013 *Introduction to forestry and Natural Resource.* Elsvier Publisher.

J.M. Kerr, 1997. *Natural Resource Economics-Theory and Application in India,* Oxford &IBH.

Joshi. SS. and T.R. Kapoor., 2001. *Fundamental of farm business Management.* Kalyani Publishers

Makchau JP & Malcolm LE.1986.*Economics of Tropical Farm Management.*Cambridge Univ. Press.

Nautiyal JC. 1988. *Forest Economics, Principles and Applications*; Natraj Publ.

Panda SC 2011. *Farm management and Agricultural Marketing* ,Kalyani Publishers.




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Shanley Alan R P. 2001 *Tapping the green Market: Management and Certtification of Non- Timber Forest Products*. Amazon.

Sharma LC. 1980. *Forest Economics -Principles and Applications*;Natraj Publ.

W.A. Lauscher, Introduction to forest Rewsource Economics.

## PAPER IV. TREE BUSINESS MANAGEMENT CR.4 (3+1)

### Objective

To develop understanding and management skills of the student with special reference to tree farm business management.

### Theory

Tree Farm : concepts, present scenario, and business application. Relationship of farm sciences with other sciences.Types of tree Farm in India, nature, scope and function of farm business management. Principles involved in Tree farm management decision making. Law of diminishing returns, substitution law, cost and price principle, depreciation.Principles of farm planning and budgeting.Working out existing and alternative farm plans. Importance of farm records, types of physical and financial records, Farm business efficiency measures.Fundamentals of inventory.Management of special farm projects like, nursery, plantations Teak, Eucalyptus, Bamboo, Sissoo, and Terminalia, sericulture.Farm labour and its problems.Labour efficiency measurement, work allocation, raising labour productivity, staff control, work progress charts. Farm capital and its problems, Farm machinery and its working principle, Field assessment for species selection and growth analysis of tree in the farm.

### Practical

Visit of agricultural farm, plantations. Calculation of fertilizers and compost quantity in different tree farms.Formulation of farm budget. Cost of production, maintenance of single and double entry system of account, preparation of farm records. Farm tools and its use in tree farm.

### Suggested Readings:

Bamoul WJ &Oates WE. 1975. *The Theory of Environmental Policy.* Prentice Hall.

Busby RJN. 1981. *Investment Appraisal in Forestry.* Forestry Commission Research Station, Surveys.

FAO 1986.*Guidelines to Project Evaluation.*NatrajPubl.

FAO, 1981.Tropical Forest Resources Assessment Project (In the Framework of Gems). *Forest Resources of Tropical Africa.*Part 1 & 2 *RegionalSynthesis.*

Joshi. SS. and T.R. Kapoor., 2001. *Fundamental of farm business Management.* Kalyani Publishers.

Ken JM, MarothiaDK, Singh, K Ramaswamy,C&Bentley WR.1997, *Natural Resource Economics-Theory and Application in India,* Oxford &IBH.

MakchauJP &Malcolm LE.1986.*Economics of Tropical Farm Management.*Cambridge Univ. Press.

Nautiyal JC. 1988. *Forest Economics - Principles and Applications*;Natraj Publ.

Panda SC 2011. *Farm management and Agricultural Marketing* ,Kalyani Publishers

Sharma LC. 1980. *Forest Economics -Principles and Applications*;Natraj Publ.

## PAPER V. FOREST MANAGEMENT FOR ENVIRONMENT CONSERVATION CR.4 (3+1)

### Objective

To develop understanding and management skills of the student with special reference to Environment conservation

### Theory

Definition, concept and principle of sustainable forest management. Problems in modern forest management, ITTO's principles, Montreal Process, SFM within the context of climate change. Sustainable energy and NTFP management, Sustainable harvesting, Gender sensitization in SFM, Process flow for women involvement SFM.Concept of participatory development. Participatory management and key elements of processes for planning and implementation, monitoring and evaluation.Concept of PRA &RRA ,techniques& tools of PRA. Importance of PRA, problems in PRA, RRA applications. Watershed Management: Concept, Scope, importance and Principles of watershed management. Application of Remote sensing & GIS for sustainable forest management.Criteria and Indicators of SFM, Bhopal India Process. CAMPA, JFM, Assistant natural regeneration, Forest Certification. Concept of tree outside forest.

### Practical

Practice of participatory rural appraisal technique.Preparation of micro plan for sustainable forest management.Resource survey and preparation of resource map.Exercises on designing training program for sustainable forest management.Reading of watershed map: Region/Basin /Catchment/Watershed preparation of classification chart.Writing news items, success stories, leaflets, and folders for the SFM.Visual interpretation of imageries and preparation of land use land class classification.Digitization of raster data.

### Suggested Readings:


Bhattacharya, P et al. 2008., *Joint Forest Management in India in 2 Vols*. Today's and tomorrow Printers and Publishers.

Lal J.B. 2011. *Farm Management Classical Approach to current imperatives*, Natraj Publication.

Neela Mukherjee. *Participatory Appraisal of Natural resources*, Concept publishing company new Delhi.

Osmoston.*Managemeent of forest* , International Book Distributors.

S.K. Gupta. *Aspects of sustainability of JFM*.,Bishen Singh Mahendrapal Singh.

Sen Rajkumar2012. *Forest Management and Sustainable Development.* Today's and tomorrow Printers and Publishers.

Suresh Sachdeva,M.L.Mourya. *Management concept practices*, Y.K. Publishers *Agra.*

## SEMESTER- IV

This semester will have following training programmes.

1. **Field Training (Attachment with State Forest Department for analysis of Forest Management patterns & Management techniques)**

**Specialization: Forest management**

Visit to modern forest nurseries, herbal gardens and watersheds. To study the medicinal and aromatic plants diversity, their conservation and domestication. Study the felling and logging operations, timber lots and industrially important products. Introduction to Working Plan, data generation-enumeration and volume/yield calculation. Writing of compartment history files. Study the catchment area treatment plant and FDA. Study the Regeneration and Management of regionally important forestry tree species. Laying out sample plots, stump analysis, preparation of local volume table and use of forestry field equipments/ instruments. Visit to National Parks, Sanctuaries and Bio-sphere reserves. Visit to ecologically degraded areas around cement plants, mined areas etc and study rehabilitation measures adopted. Visit to plantation site and data collection for its growth pattern and feasibility.

2. **Industrial Training**

Study the nature structure of Industrial Training and Business Organization: Raw material procurement and processing; Production, Marketing and Economics at Wood workshop and saw mills/wood seasoning and preservation treatment units/Pulp and Paper Industries/ Katha making industry/ Resin, Turpentine, Gums, Tendupatta, Chironji Industry; Herbal Pharmacies and other wood product industries.

3. **Computational skills.**

Introduction to computers and personal computers. basic concepts (H/W, S/W, Input & Output Devices) operating system (Introduction of open source and closed source), DOS and Windows XP/7/8, introduction of programming languages, BASIC languages concepts basic and programming techniques, MS Office. Win Word, Excel, Power Point, MS Access.Introduction of Statistical & Remote sensing softwares.Introduction to Multi-Media and its application.Introduction to Internet.

4. **Student Project**

## Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$\textbf{SGPA } (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\textbf{CGPA} = \sum(Ci \times Si) / \sum Ci$$

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

## Illustration of Computation of SGPA and CGPA and Format for Transcripts

i. Computation of SGPA and CGPA

Illustration **for SGPA**

| Course | Credit | Grade letter | Grade point | Credit Point (Credit x Grade ) |
|---|---|---|---|---|
| Course 1 | 3 | A | 8 | 3 X 8 = 24 |
| Course 2 | 4 | B+ | 7 | 4 X 7 = 28 |
| Course 3 | 3 | B | 6 | 3 X 6 = 18 |
| Course 4 | 3 | O | 10 | 3 X 10 = 30 |
| Course 5 | 3 | C | 5 | 3 X 5 = 15 |
| Course 6 | 4 | B | 6 | 4 X 6 = 24 |
| | 20 | | | 139 |

**Thus, SGPA =139/20 =6.95**

Illustration **for CGPA**

| Semester 1 | Semester 2 | Semester 3 | Semester 4 | Semester 5 | Semester 6 |
|---|---|---|---|---|---|
| Credit : 20<br>SGPA:6.9 | Credit : 22<br>SGPA:7.8 | Credit : 25<br>SGPA: 5.6 | Credit : 26<br>SGPA:6.0 | Credit : 26<br>SGPA:6.3 | Credit : 25<br>SGPA: 8.0 |

$$\text{Thus, } \textbf{CGPA} = \frac{20 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0}{144} = \mathbf{6.73}$$

ii. Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the HEIs may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.