

**CURRICULUM
OF
FORESTRY, RANGE WATERSHED
AND WILDLIFE MANAGEMENT**

FOR

BS/B.Sc. (Hons.)

(Revised 2010)



**HIGHER EDUCATION COMMISSION
ISLAMABAD**

CURRICULUM DIVISION, HEC

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum one can judge the state of intellectual development and the state of progress of the nation. The world has turned into a global village; new ideas and information are pouring in like a stream. It is, therefore, imperative to update our curricula regularly by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor's Committee, the curriculum of a subject must be reviewed after every 3 years.

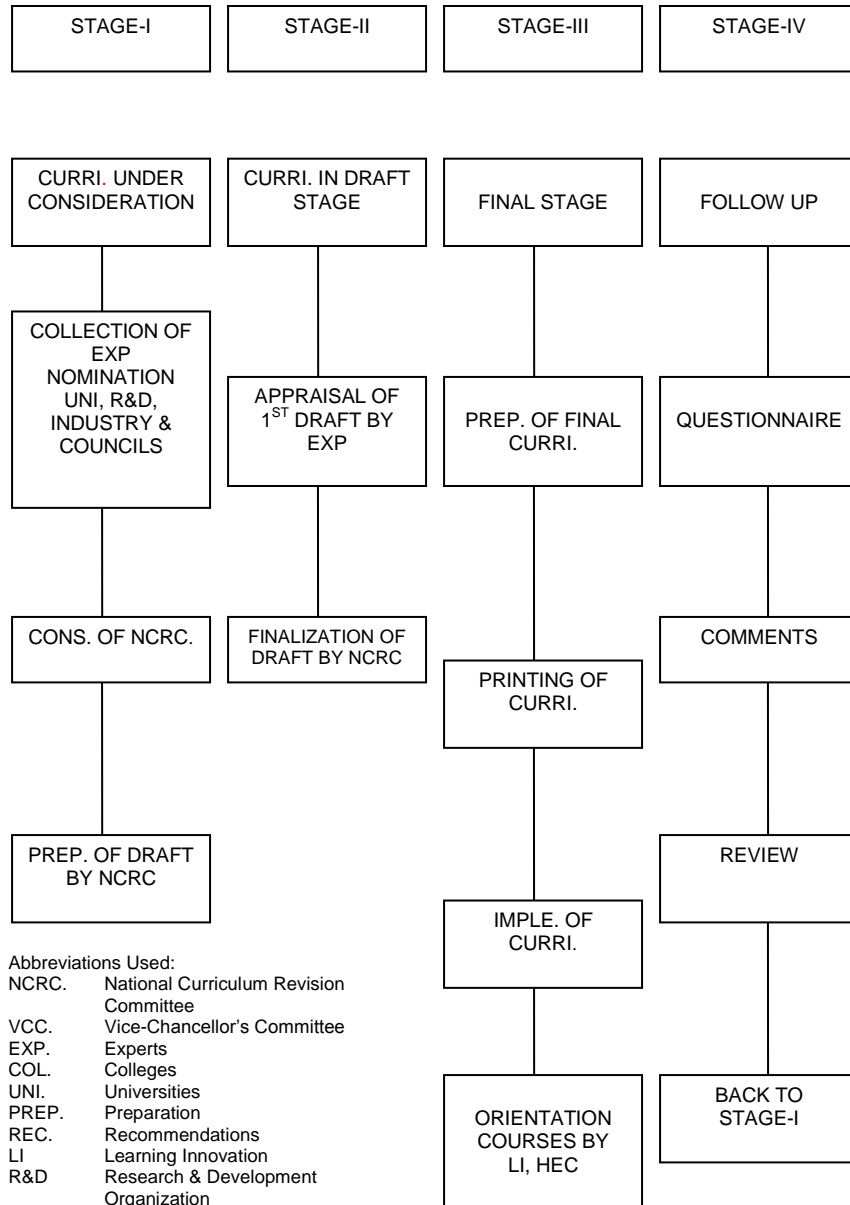
A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Agriculture met in 2009 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The Bachelor (BS) degree shall be of 4 years duration, and will require the completion of 130-140 credit hours. For Agriculture degree programme 77% of the curriculum will consist of discipline specific and supporting Agriculture courses, and 23% will consist of compulsory and general courses.

For the purpose of curriculum revision various committees are constituted at the National level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations, respective accreditation councils and stake holders. The National Curriculum Revision Committee for Forestry in a meeting held on May 17-19, 2010 at HEC Regional Centre, Lahore in continuation of preliminary meeting held on October 17, 2009 at HEC Islamabad, revised the curriculum in light of the unified template. The revised curriculum is being circulated for implementation in the concerned institutions.

PROF. DR. ALTAF ALI G. SHAIKH
Member Academics

March 2010

CURRICULUM DEVELOPMENT



INTRODUCTION

The final meeting of National Curriculum Revision Committee (NCRC) in Forestry was held on May 17-19, 2010 at HEC RC Lahore. The objective of the meeting was to prepare a draft curriculum of 4-year B.Sc, (Hons) in Forestry by keeping in view the template of Agriculture disciplines, developed by the Conveners / experts of Agriculture on October 17, 2009 at HEC Islamabad and the latest developments and research in the field of Forestry. The following experts from the country attended the meeting:

Dr. Muhammad Tahir Siddiqui Associate Professor Department of Forestry University of Agriculture, Faisalabad	Convener
Dr. Syed Moazzam Nizami Assistant Professor Department of Forestry & Range Management Arid Agriculture University, Rawalpindi.	Secretary/ Member
Mr. Hakim Shah, Director General Forest Education Division, Pakistan Forest Institute, University of Peshawar, Peshawar	Member
Dr. Muhammad Saeed, Associate Professor Department of Plant Sciences Balochistan University of Information Technology, Engineering Management Science Quetta, City Campus	Member
Dr. Din Muhammad Zahid Khan, Associate Professor, Department of Forestry, Faculty of Agriculture, B.Z. University, Multan	Member
Dr. Ejaz Ahmad DDG WWF 60-Bazar Road, Sector G-6/4, Islamabad	Member

Syed Said Badshah Bukhari, D.G Pakistan Forest Institute (PFI), Peshawar.	Member
Dr. Muhammad Sajjad Haider Assistant Professor Department of Forestry Range & Wildlife Management, University of Sargodha.	Member
Mr. Muhammad Nafees, Assistant Professor, Deptt of Forestry, College of Agriculture, Islamia University Bahawalpur.	Member
Mr. Mohammad Amin Lecturer, Department of Forestry Shaheed Benazir Bhutto University, Sheringal, Dir Upper (Dir Balla)	Member
Prof. Dr. Nowshad Khan, Chairman, Department of Agricultural Sciences, Allama Iqbal Open University, Islamabad	Member

The meeting started with recitation of the Holy Quran. Madam Ghayyur Fatima, Director Curriculum welcomed the participants on behalf of the Chairman, HEC Islamabad and assured them that all possible facilities would be provided to them during the meeting. She asked the members to revise the draft curriculum of Forestry in line with the framework / template of 4-year B.Sc (Agriculture) and curricula of Forestry of best international universities. She also said that before the finalizing, the draft curriculum will be sent to an expatriate Pakistani expert for comments. Earlier Mr. Muhammad Javed Khan, Adviser (Academics), HEC Islamabad pointed out in the preliminary meeting that most of the reference books in the existing curriculum of Forestry are very old and required to be replaced by the latest edition in the revised curriculum. The committee then unanimously selected Dr. Muhammad Tahir Siddiqui as convener of the meeting and Dr. Syed Moazzam Nizami as Secretary.

A detail discussion on current and important issues of forestry was carried out on first day and it was decided that proposed revised forestry curriculum should reflect the new ideas regarding changing scenario of

forest resources in the country and in the world. All universities and institutions that are imparting forestry education at graduation level should have common, comprehensive and updated curriculum according to the demand of Provincial Forest Departments and allied organizations.

The house agreed to proposed new contents in the existing courses focusing core and hot issues of the forestry. All courses were reviewed and improved by incorporating the latest issues in the contents. Some new subjects were also included in the scheme which was considered important in challenging world.

The house tried to find new books for the entire courses but due to unavailability of new books some core and old books were retained along with some new books.

Template For Bs Forestry/ B. Sc. Hons. Agric. Major in Forestry Degree

The template provided by the HEC for 4 year B. Sc (Hons.) in Forestry was as follows:

1.	Compulsory Courses	Credits Hours
	Mathematics / Biology	3 (3-0)/ 3(2-1)
	Statistics 1 & 2	3 (3-0), 3(3-0)
	Computers / IT	3 (2-1)
	Pakistan Studies	2 (2-0)
	Islamic Studies	2 (2-0)
	Communications Skills	3 (3-0)
	English	3 (3-0)
	Basic Agriculture	3 (2-1)
		Sub-Total 28
2.	Interdisciplinary Foundation Courses	
	Agronomy	3 (2-1)
	Plant Breeding & Genetics	3 (2-1)
	Entomology	3 (2-1)
	Plant Pathology	3 (2-1)
	Food Technology	3 (2-1)
	Horticulture	3 (2-1)
	Soil Sciences	3 (2-1)
	Agriculture Economics	3 (2-1)
		Sub-Total 24
3.	Supporting Courses {6-8 courses, each of 3 Cr. Hr, amongst below}	
	Agriculture Extension	
	Forestry & Range Management	
	Animal Science	
	Marketing & Agri Business	
	Rural Development	
	Human Nutrition	
	Agriculture Chemistry	
	Agriculture Engineering	
	Water Management	

Any other discipline recommended by the university Board of Studies, or Advanced Studies and Research Board, or Academic Council, as the case may be. It again depends on the respective Board of Studies, when / in which semester above all course to be offered.

Sub-Total 18-24

Sub-Total of Credit hours during the first four semesters : 70-76

Sub-total of Credit hours during Semester 5, 6, 7 & 8 : 56-60

Project / Internship credit hours : 04

Grand Total of Credit hours for B.Sc.(Hons.) Agri : 130-140

- 1 1 credit of theory = one contact hour per week for 16-18 weeks and 1 practical/Lab hour = 3 contact hours per week for 16-18 weeks.
- 2 In case of non availability of department of supporting courses, courses from foundation courses can be opted

Note:

The Agricultural Universities will offer over 70-76 credit hours for all Compulsory, Interdisciplinary and supporting courses during first four semester. Out of which the two supporting courses of Forestry will be:

Introduction to Rangelands and Wildlife Management 3(2-1)

Introduction to Forest and Watershed Management 3(2-1)

**Scheme of Studies For BS/B.Sc. (Hons.)
Forestry (4 years)**

I-IV semester

Semester I		
S.#.	Course	Credit hours
1.	Biology	3 (2-1)
2.	Mathematics	3 (3-0)
3.	Introduction to information & Communication Technologies	3 (2-1)
4.	Introduction to Forestry	2 (2-0)
5.	English-I (Functional English)	3 (2-0)
6.	Pakistan Studies	2(2-0)
7.	Islamic Studies /Ethics (for non- Muslims)	2(2-0)
	Total	18 (15-2)

Semester II		
1.	Elementary Statistics	3 (3-0)
2.	English-II (Communication Skills)	3 (3-0)
3.	Introduction to Environmental Science	3(2-1)
4.	Geology & Soil Science	3 (2-1)
5.	Forest Pathology	3(2-1)
6.	Principles of Economics	3(3-0)
	Total	18(15-3)

Semester III		
1.	Sociology	2 (2-0)
2.	Public Policy	2 (2-0)
3.	Forest Genetics	3(3-0)
4.	Forest Ecology	3 (3-0)
5.	Forest Entomology	3 (2-1)

6.	Plant Taxonomy	3 (2-1)
7.	Forest Accounts and Procedure	2(2-0)
	Total	18 (16-2)

Semester IV

1.	Forest Engineering I	3 (2-1)
2.	Biodiversity and Climate Change	3 (3-0)
3.	Participatory Forestry	3 (3-0)
4.	Non Wood Forest Products	3 (3-0)
5.	Integrated Land Use Management Systems	3 (3-0)
6.	Forestry Extension	3 (3-0)
	Total	18 (18-1)

* For Semester V_ VII the courses for B.Sc.(Hons.)Agriculture (Major in Forestry) and BS Forestry (4 years) will be same and are as under:

[5th – 8th Semester]

Semester V

1	Energy Plantation and Bio Fuels	3(2-1)
2	Forest Policy and Law	3 (3-0)
3	Wood Science and Technology	3 (2-1)
4	Forest Survey and Leveling	3 (2-1)
5	Silviculture-I	2(2-0)
6	Forest Engineering II	2 (1-1)
	Total	16(12-3)

Semester VI

1	Forest Management (including field tour)	4 (2-2)
2	Watershed Management	3 (2-1)
3	Range Management	3 (2-1)
4	Wildlife Management	3 (3-0)

5	Forest Biometrics	3 (3-0)
	Total	16 (12-4)

Semester VII

1	Ecotourism and Park Management	2(2-0)
2	Forest Resource Economics	2(2-0)
3	Silviculture-II	3 (3-0)
4	Specialization (Any one from following)	9 credit hours
	Total	16

One of the following specializations may be opted for:

* **Subject to approval of university**

1.	Forest Management	9 (6-3)
	i. Forest Inventory Techniques	3 (2-1)
	ii. Stand Level Planning	3 (2-1)
	iii. Sustained Forest Yields	3 (2-1)
2.	Watershed Management	9 (6-3)
	i. Soil Conservation Techniques	3 (2-1)
	ii. Forest Meteorology	3 (2-1)
	iii. Forest and Range Hydrology	3 (2-1)
3.	Range Management	9 (7-2)
	i. Range Vegetation Analysis	3 (2-1)
	ii. Livestock Nutrition and Grazing Management	3 (2-1)
	iii. Drought Management in Rangelands	3 (3-0)
4.	GIS and Remote Sensing Techniques	9 (3-6)
	i. Digital Cartography	3 (1-2)
	ii. Land Use Planning	3 (1-2)
	iii. Forest Assessment and Monitoring	3 (1-2)

5.	Participatory Forest Management	9 (7-2)
	i. Community Based Forestry	3 (3-0)
	ii. Participatory Forest Management Planning	3 (2-1)
	iii. Participatory Forest Assessment	3 (2-1)
6.	Sericulture	9 (5-4)
	i. Silkworm Rearing	3 (2-1)
	ii. Silk Seed and Cocoon Technology	4 (2-2)
	iii. Horticulture	2 (1-1)
7.	Wood Sciences and Technology	9 (5-4)
	i. Wood Harvesting Techniques	2 (1-1)
	ii. Wood Structure and Identification	2 (1-1)
	iii. Wood Testing and Processing	2 (1-1)
	iv. Wood Based Products	3 (2-1)
8.	Wildlife Management	9 (7-2)
	i. Wildlife Biology and Ecology	3(3-0)
	ii. Wildlife Survey Techniques	2(1-1)
	iii. Wildlife Policies, Laws and Administration	2(2-0)
	iv. Protected Area Management	2(1-1)
9.	Agro Forestry	9 (7-2)
	i. Agro Forestry Systems	3 (3-0)
	ii. Farm Forestry Management	3 (2-1)
	iii. Marketing of Agro Forestry Products	3 (2-1)
	Forest Engineering and Logging	
10.	i. Forest Machinery	9 (7-2)
	ii. Forest Logging	3 (3-0)
	iii. Applied Mechanics of Forestry	3 (2-1)
		3 (2-1)
11.	Environmental Forestry	9 (8-1)
	i. Environment and Forestry	2 (2-0)
	ii. Environmental Pollution and Mitigation	3 (3-0)
	iii. Environmental Impact Assessment	2 (1-1)
	iv. Environmental Policies and Laws	2 (2-0)

12.	Forestry and Climate Change	9 (8-1)
	i. Forest, Carbon and Climate Change	3 (3-0)
	ii. Clean Development Mechanism and Carbon Credits	3 (3-0) 3 (2-1)
	iii. Trees in changing Climate (Tree Functional Biology)	
13.	Non Wood Forest Products	
	i. Production Technology of Medicinal Plants	9 (6-3) 2 (1-1)
	ii. Pharmacognocny	2 (1-1)
	iii. Sericultural Techniques	1 (1-0)
	iv. Apiculture	2(1-1)
	v. Minor Forest Produce (Mazri, Mushroom, Resin,etc)	1 (1-0)
	vi. Economics of Non Wood Forest Products	1 (1-0)

Semester VIII

1.	Forest Management Plan – I	3(3-0)
2.	Forest Management Plan – II	4(0-4)
3.	Research Methods and Scientific Writing	4(4-0)
4.	Research Project / Internship	4(0-4)
	Total	15 (7-8)
	Grand Total	134(103-32)

DETAILS OF COURSES FOR BS/B.Sc. (HONS.) FORESTRY

English I (Functional English)

Credit Hrs. 3

Objectives:

Enhance language skills and develop critical thinking.

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening

To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. **Functional English**
 - a) Grammar
 1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
 2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
 - b) Writing
 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
 - c) Reading/Comprehension
 1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

English II (Communication Skills)

Credit Hrs. 3

Objectives:

Enable the students to meet their real life communication needs.

Course Contents

Paragraph writing

Practice in writing a good, unified and coherent paragraph

Essay writing

Introduction

CV and job application

Translation skills

Urdu to English

Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills

Letter/memo writing, minutes of meetings, use of library and internet

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:**Communication Skills**

- a) Grammar
 - 1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- b) Writing
 - 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
 - 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
 - 1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 - 2. Reading and Study Skills by John Langan
 - 3. Study Skills by Richard Yorky.

English III (Technical Writing and Presentation Skills) Crh. 3**Objectives:**

Enhance language skills and develop critical thinking

Course Contents**Presentation skills**

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

**Technical Report writing
Progress report writing**

Note: Extensive reading is required for vocabulary building

Recommended books:

Technical Writing and Presentation Skills

- a) Essay Writing and Academic Writing
 1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
 2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
 3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
- b) Presentation Skills
- c) Reading

The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

ISLAMIC STUDIES (Compulsory)

Credit Hours 2(2-0)

Objectives:

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Detail of Courses

Introduction to Quranic Studies

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Ihزاب Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

- 1) Life of Muhammad Bin Abdullah (Before Prophet Hood)

- 2) Life of Holy Prophet (S.A.W) in Makkah
- 3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina
- 3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith
- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

Islamic Culture & Civilization

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quranic & Science

Islamic Economic System

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

Political System of Islam

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

Islamic History

- 1) Period of Khlaft-E-Rashida
- 2) Period of Umayyads
- 3) Period of Abbasids

Social System of Islam

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

Reference Books:

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, "Introduction to Islam"
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Pakistan Studies (Compulsory) 2(2-0)

Introduction/Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

3. Contemporary Pakistan

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.

4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

MATHEMATICS I (ALGEBRA)

3(3-0)

Prerequisite(s): Mathematics at secondary level

Credit Hours: 3 + 0

Specific Objectives of the Course:

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin, Boston (suggested text)

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

MATHEMATICS II (CALCULUS)

3(2-1)

Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0

Specific Objectives of the Course:

To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

MATHEMATICS III (GEOMETRY)

3(3-0)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0

Specific Objectives of the Course:

To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Geometry in Two Dimensions: Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

Conic Sections: Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books:

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

Note:

- 1. Two courses will be selected from the following three courses of Mathematics.**
- 2. Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.**

Statistics-I

Credit 3 (2-1)

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median, quartiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

Practicals

- a. Frequency Distribution
- b. Stem-and-Leaf diagram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kurtosis

Recommended Book

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A Concise Course in A. Level Statistics with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2nd Ed. (1986) Fran II. Dietrich-II and Thomas J. Keans

Statistics-II

Credit 3 (2-1)

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Inference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using χ^2 (chi-square) Testing hypothesis about variance.

Practicals

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

Recommended Book

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-meterial approach, 2nd Edition, 1980 by R.G.D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2nd Edition (1980) by K.A. Gomez and A.A. Gomez

Note: *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*

Introduction to Information and Communication Technologies

3(2-1)

Pre-requisite: None

Course Description:

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

Course Contents:

Basic Definitions & Concepts

Hardware: Computer Systems & Components

Storage Devices , Number Systems

Software: Operating Systems, Programming and Application

Software

Introduction to Programming, Databases and Information Systems

Networks

Data Communication

The Internet, Browsers and Search Engines

The Internet: Email, Collaborative Computing and Social Networking

The Internet: E-Commerce

IT Security and other issues

Project Week

Review Week

Text Books/Reference Books:

Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)
Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition (McGraw HILL)
Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer
Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon Press.

Functional Biology-I**3(3-0)****Course Contents****Biological Methods**

Principles of Cellular Life
Chemical Basis
Structure and Function
Principles of Metabolism
Energy Acquisition

Principles of Inheritance

Mitosis and Meiosis
Chromosomes
Observable Inheritance Patterns
DNA Structure and Function
RNA and Proteins
Genes
Genetic Engineering and Biotechnology

Biodiversity

Fundamental Concept of Biodiversity
One or two examples of each of the following from commonly found organism
Prions
Viruses
Bacteria
Protistans
Algae
Fungi
Plants
Crops
Animals
Invertebrates

Vertebrates

Reading

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

Functional Biology-II

3(2-1)

Course Contents

Myths and Realities of Evolution

Microevolution
Speciation
Macroevolution

Level of Organization

Plants
Tissues
Nutrition and Transport
Reproduction
Growth and Development

Animals

Tissue, Organ System and Homeostasis
Information Flow and Neuron
Nervous System
Circulation and Immunity
Nutrition and Respiration
Reproduction and Development

Ecology and Behavior

Ecosystems
Biosphere
Social Interactions
Community Interactions
Human Impact on Biosphere
Environment Conservation

Reading

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

Note: *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*

INTRODUCTION TO RANGELANDS AND WILDLIFE MANAGEMENT 3(2-1)

Objectives:

To give basic knowledge of Rangelands and grasses grown in them and how they are becoming habitat of different wildlife.

Course Outlines

Theory:

1. Introduction to Rangelands, scope and importance.
2. Basic terminology,
3. Components of Rangelands
4. Constraints and problems of rangelands.
5. Rangeland Resources of Pakistan; ecological zones and vegetation types.
6. Range ecosystem,
7. Principles of Rangeland Management.
8. Grazing system of the world,
9. Grazing system and grazing pattern in Pakistan.
10. Range improvement techniques.
11. Wildlife: Definition and values,
12. Ecosystem concept, characteristics and management requirements for regional eco-systems in Pakistan including arid, wetland, forest, mountain and coastal ecosystems.
13. Introduction to protected areas (National Park, Game Reserve and Wildlife Sanctuary.
14. Introduction to National Parks of Pakistan.

PRACTICALS

1. Identification and preservations of important
2. Grasses and Plant species of Pothowar [or other nearest regional areas].
3. Visits to various Rangeland types and Plantations.
4. Quantitative analysis of range vegetation, Range frequency, relative frequency, density, relative density, cover and relative cover.
5. Measurements and analysis of wildlife population.

Recommended Books:

1. Vallentine, John, F. 2000. Grazing Management. Academic Press (Elsevier Science & Technology Books).
2. Holechek, J. et al., 1989. Range Management, Principles and Practices. Prentice Hall, Inc. Newberry. USA.
3. Quraishi, M. A. A., G.S. Khan and M. S. Yaqoob. 1993. Range Management in Pakistan, University of Agriculture, Faisalabad.
4. Mohammad, N. 1989. Rangeland Management in Pakistan. NARC Published by ICIMOD.
5. Stoddard, L.A., A.D. Smith and T.W. Box. 1975. Range Management. McGraw Hill Book Co., New York.
6. Quraishi, M.A.A., M. Ishaque, 1995. Practical Manual of Range Management, University of Agriculture, Faisalabad.

INTRODUCTION TO FOREST AND WATERSHED MANAGEMENT 3(2-1)

Objective:

To acquaint the students with basic knowledge of forestry and forest resources of Pakistan and principles used in watershed management.

Course Outlines

Theory:

1. Introduction to Forests and watersheds management.
2. Forest resources of Pakistan (description, composition, distribution and status) in different ecological zones.
3. Importance of these natural resources of Pakistan.
4. Constraints and problems in natural resource management.
5. Principles of sustainable forest management.

6. Forestry practices (Agroforestry, social forestry etc.).
7. Principles of Watershed Management.
8. Watersheds of various streams/rivers of Pakistan, their area, distribution, land use patterns, past history, climatic, physiographic, ecological and socio-economic features.
9. Hydrological cycle.
10. Management problems and potentials of various watersheds, afforestation programmes.
11. Watersheds as a sources of power generation and irrigation.
12. Watershed research and education.

Practical

1. Identification of important forest species
2. Visits to various forest types and watershed areas.
3. Watershed measurements (instruments, area, drainage, flow etc.).
4. Study of land use pattern,
5. Visit to watershed projects and river dams.

Recommended Books

1. Franzel, S.; Scherr, S.J. 2001. Trees on the Farm. CAB International.
2. Champion, H.G. et al. 1967. Manual of Silviculture for Pakistan. Pakistan Forest Institute, Peshawar.
3. Quraishi, M. A. A. 1999. Basics of Forestry and Allied Sciences. A-One Publishers, Urdu Bazar, Lahore.
4. Sharpe, G. W., Chare W. Hendee and Wenonah F. Sharpe. 1986. Introduction to Forestry. McGraw Hill Book Co., New York.
5. Sheikh, M.I. 1999. Forests and Forestry in Pakistan. A-One Publishers, Urdu Bazar, Lahore.
6. Quraishi, M.A.A. 2002. Watershed Management in Pakistan. Department of Forestry. UAF.
7. Singh, S.P. and Singh J.S. 1992. Forests of Himalaya. Nainital, Gtanodaya Prakashan.
8. Quraishi, M.A.A. and M.T. Siddiqui. 2002. Practical manual of watershed management. Department of Forestry. UAF.
9. Siddiqui, M.T., R.Sands and A.H. Shah. 2009. Glossary of forestry terms. Pulschay Publishers. Faisalabad.

BIOLOGY

3(2-1)

Botany

1. Definition and Branches of Botany
2. Morphology
 - Parts of a typical plant
 - Structure of monocot and dicot seeds
 - Germination of seed; Epigeal and Hypogeal
 - Stem; description of different kinds of stem
 - Leaf; description of various kinds of leaves
 - Inflorescence; description of different kinds of inflorescence
 - Flower; description of flower and its parts and pollination
 - Fruit; description of fruits and mode of dispersal of seed
3. Reproduction
 - Reproduction in flowering plants (sexual), description of various methods of vegetative propagation (asexual)
4. Histology; description of internal structure of root, stem and leaf
5. Physiology
 - Description of mechanism of absorption of water and mineral salts and ascent of sap
 - Photosynthesis; necessary conditions, biochemistry and its economic importance
 - Respiration: Aerobic and an aerobic, limiting factors, comparison with photosynthesis and metabolism
 - Growth and developments; development of roots and shoots, factors affecting the development of plant organs
 - Movement and storage of materials in green plants

Zoology

1. Differences between plants and animals
2. Protoplasm and its chemical composition
3. Structure of animal's cell
4. Animal's cell division (Mitosis and Meiosis)
5. Classification of animal kingdom with characteristics of important phyla
6. Digestive system of animals and mechanism of digestion in animals
7. Blood vascular system or circulatory system of animals
8. The blood and its composition
9. Methods of respiration of animals
10. Methods of excretion of animals
11. Patterns of reproduction in animals. Hormonal control of female reproductive cycle

12. Nervous system of animals
13. Methods of locomotion in animals
14. Organic evolution- Evidences of evolution
15. Theories of evolution;
 - i. Lamarck's theory
 - ii. Darwin's theory
 - iii. Mutation theory
16. Animal's behaviors- Instinct behavior, Learning behavior, Social behavior

Practical Botany:

1. Demonstration, drawing and labeling of various parts of dicot seeds.
2. Phylotaxy of leaves, simple and compound leaves and modification of leaves to scales, thorns, tendrils etc.
3. Aerial and underground stem; stem modification to thorn and tendril, Rhizomes, corns, tubers, bulbs.
4. Roots; forms of roots
5. Racemos and Cymose inflorescence
6. Study of parts of flowers and fruits

Practical Zoology:

Identification and sketching of labeled diagrams and classification of the following animal specimen

- i. Amoeba, Paramecium
- ii. Hydra, Red coral
- iii. Roundworm, Earthworm
- iv. Cray fish, cuttle fish, Snail
- v. Star fish, Sea Urchin, Sea Cucumber
- vi. Rahu fish, Frog
- vii. Lizard, Snake, Rat, Bat

Recommended Books:

Botany:

1. Ahmad, S.S. 1990. A text book of Botany. Sheikh & Sons Publishers, 42 Urdu Bazar, Lahore.
2. A.C. Dutta 1950. A class book of Botany, Oxford University, Press
3. Lawson & Sahni 1954. Text Book of Botany. University Tutorial Press, London

4. Dr. Muhammad Nawaz, 1980. A text book of general botany Vol. II. Angiosperms (1). Academic Publisher, Talimi Markaz Ltd, 3 Kabir Street, Urdu Bazar, Lahore.

Zoology:

1. Ahmad, S.S (1966)- A text Book of Intermediate Zoology
2. Biological Sciences- An Enquiry into life- Punjab Text Book Board-Lahore
3. Text book of biology class XI & XII, Published by Idara-i-Farogh-i-Taleem, Peshawar, Khyber Pukhtoonkhwa Text book Board, Peshawar.

INTRODUCTION TO FORESTRY

2(2-0)

Objective:

To enable the students to acquaint themselves with forests, their importance and issues concerning forest protection and remedial measures.

Course Outline

1. Definition of forest and forestry.
2. Forest resources of Pakistan and provinces, distribution of forests in different ecological zones with species composition.
3. Economic, social and environmental importance of forests.
4. Main issues in protections and development of forest resources in Pakistan.
5. Measures taken for protection and development of forest resources (legal, technical, social and financial).

Practical

Field: Study forest types, species, growth, economic social, ecological and environmental aspects of forestry.

Recommended Books:

1. Champion, H.G., Seth, S.K. and Khattak, G.M. (1965): Forest Types of Pakistan, Pakistan Forest Institute, Peshawar.
2. The State of Forestry in Pakistan, (annual reports) Forest Economics Branch, Pakistan Forest Institute, Peshawar.

3. INTRODUCTION TO ENVIRONMENTAL SCIENCE

Objective:

To educate the students about the concept and importance of environment, factors leading to pollution of environment and solution of environmental problems.

Course Outline:

1. Introduction, definition and importance of environment.
2. The interactions of human beings and environment. Study of environmental pollution such as greenhouse effect, air and water contaminants, noise pollution, and light pollution.
3. The effects of global climate change.
4. Environmental Impact Assessment (EIA).
5. Addressing environmental problems through biological and engineering techniques.
6. Environmental policy and Laws (national and international).

Practical:

Field: Visit to different areas to study the effects of environmental degradation and measures taken for rehabilitation of the environment.

Field: EIA of various activities such as road construction, afforestation, industries and brick kilns.

Recommended Books

1. Brown, L.R., Brown, F.P. and Postel Sandra (1991): Saving the Planet: How to Shape an Environmentally Sustainable Global Economy Book Description, W. W. Norton & Company, USA.
2. Calver, Mike, Lybery, A. and Comb, J.M. (2009). Environmental biology. Cambridge University Press, USA.
3. Maslin, Mark 2008: Global warming. Oxford University Press, USA

4. GEOLOGY AND SOIL SCIENCE

Objective:

To educate the students about geology and soil science and importance of the subject in forestry.

Part-I Geology

1. **Introduction:** Definition and scope; general idea regarding the earth's crust and its constitution.
2. **Mineralogy:** Definition and physical characteristics of minerals such as crystal form, cleavage, hardness, specific gravity, luster,

feel, colour, and streak, Study of essential minerals such as quartz, feldspars, mica, pyroxenes, amphiboles, and olivine, accessory minerals such as calcite, gypsum, tourmaline, apatite, chlorite, talc, serpentine, kaoline, dillimanite, and zoolites, iron, manganese and aluminum ores, major minerals of economic importance.

3. **Petrology:** Classification of rocks; igneous, sedimentary, and matamorphic, Rock structures and textures igneous rock; plutonic, hypabyssal and volcanic such as granites, syemites, diorites, gabbros, obsidian and basalt. Sedimentary rocks; sandstones conglomerates, shales, limestones, peat and coal. Metamorphic rocks; slaies, quartzites, schists, gneisses and marbles.
4. **Structural Geology:** Structural features of rock masses according to mode of origin; strike, dip, folding, anticlines, synclines, faults, stratification and lamination, overlap, unconformity, outcrop, joints.
5. **Physical Geology:** Subterranean and atmospheric agencies; crustal movements, volcanoes and earthquakes. Underground and surface water; springs, rivers and glaciers. Wind deposits. Rock disintegration and formation of soil.

Part-II Soil Science

1. **Introduction:** Definition and scope of soil science. Soil nutrients and their relation to plant growth.
2. **Soil formation processes:** Relationship of important, rock minerals to soil formation. Silicates and alumino-silicates. Weathering of rocks.
3. **Soil Profiles:** Definition and original horizon designation and their sub-division, development of soil horizons under various forest types.
4. **Physical properties of forest soil:** Soil texture, soil structure, soil porosity, soil temperature, soil water holding capacity, soil hygroscopicity and soil permeability.
5. **Soil organic matter:** Different types of humus forming agencies. Necessity for the maintenance of humus content of forest soil; influence of humus on the physical, chemical and biological composition of soil, Humus and soil fertility; effect of fires on humus and forest soil. Contribution to nitrogen in soil; symbiotic fixation of nitrogen. Nitrogen cycle.
6. **Absorptive properties of soil:** Ion exchange capacity. Function of lime in soil, soil pH; acidity and alkalinity in soils, buffer action.
7. **Soil-Water Relationships:** Static and dynamic aspects of soil moisture study; moisture contents of soil, maximum water

capacity, hygroscopic coefficient, moisture equivalent sticky point, wilting coefficient and field moisture capacity.

Practicals:

Geology

1. General examination of mineral and rock specimens
2. Study of models illustrating forms of crystallization
3. Study of physical characteristics of some typical mineral specimens.
4. Study of hand specimens of following minerals: quartz and its varieties, feldspars, micas, pyroxenes, amphiboles, clivine, secondary and accessory minerals, ore forming minerals and economic minerals.
5. Study of hand specimens of following rocks: granites, syenites, gabbros, obsidian and basalt, sandstone, limestone, shales, conglomerates, gneisses, quartzites, marble, schists and gneisses.

Soil Science

1. Study of soil profile in the fields and the textural classification of soil.
2. mechanical analysis of soil by hydrometer method
3. Determination of soil organic matter by wet oxidation method.
4. Estimation of total nitrogen.
5. Determination of cation exchange capacity.
6. Estimation of exchangeable calcium and magnesium in soil
7. Determination of pH and exchangeable acidity.
8. Determination of total soluble salts and their composition in soil. Estimation of free CaCO_3 in soil.
9. Quick test for soil available nutrients.

Recommended Books:

1. Brinkman, R. Pakistan Soil Bull. 2 & 4 Central Soil Res. Inst. Lahore 1971
2. Wadia, D.N. Geology of India, Macmillan and Co., London, 1960
3. Ashraf, M.R., Brinkman and M.A. Mian. Pak. Soils bull No.1 Central Soil Res. Inst, Lahore, 1970
4. Richard, L.A. Alkali. Diagnosis and Improvement of Saline and Soils, U.S. Deptt: of Agri. Handbook 60, 1954.
5. Russell, E.W. Soil Conditions and Plant Growth, 9th Ed. Longmans, London: 1961
6. Wilde, S.A. Forest soils and Forest Growth, Chronica Botanica Co., Waltham Mass: 1946

7. Armson, K.A. Forest Soils; Properties and processes, University of Toronto, Canada, 1977
8. Pritchett, W.L. Properties and Management of forest Soils. John Willey & Sons, New York, 1979

5. FOREST PATHOLOGY

Part- 1: Mycology

1. Introduction to fungi (Hyphae, mycelium, fungal body, fungal tissues, cell structure)
2. General characters of fungi
3. Modes of nutrition of fungi
4. Methods of reproduction of fungi
5. Important phyla and their brief characteristics
6. Importance of fungi to human's affairs
7. Useful and harmful aspects of fungi
8. Importance of mycorrhiza
9. Identification, economic importance, mode of nutrition, methods of reproduction and classification of the following fungi of economic importance: Pythium, Fomes, Gandoderma, Lenzites.

Part- 2: Pathology / Nematology

1. Causes, classification and signs of diseases of forests
2. Principles of forest disease control
3. Factors that affecting incidence of plant diseases
4. Role of various plant pathogens in the forests
5. Host parasite relationship
6. Management of forest diseases
7. Major diseases of the following forest trees with symptoms, mode of infection and control measures; Shisham, Mulberry, Poplars, Chir, Kail,,Deodar, Junipers, Nurseries and Decay in timber
8. Importance, morphology, symptoms, classification and control of nematodes
9. A brief on Bacteria and viruses
10. Fungicides and their uses

Practical

1. Sketching and labeling of important fungi relating to forest diseases.
2. Record of important diseases in the practical notebook for presentation in the examination.

3. Identification of important diseases of forest trees: study of diseased plant material;
4. Collection of mycological specimens

Recommended Books:

1. Alexopoulos, C.J (1962). Introductory Mycology 2nd edition. Published by the National Book Foundation Islamabad.
2. Boyce, J.C (1961). Forest Pathology 3rd. Ed. McGraw Hill Book CO. New York.
3. Bakhshi, B.K 1967. Forest Pathology- Principles and practices in Forestry. Controller of Publications, New Delhi, India.
4. P.D Manion 1996. Tree Disease Concept. Pearson Deucation Press.
5. F.A Tainter and F.H. Baker. 1996. Principles of Forest pathology. John Willy & sons.
6. Alexopoulos, C.J. (1962). Introductory Mycology. Published by the National Book Foundation Islamabad

6. PRINCIPLES OF ECONOMICS

Objective:

The objective of this course is to make students understand the basic principles of economics and their application in the field of Forestry and allied disciplines

1. **Definition of economics:** Positive and normative science, value, theories of value ordinal and cardinal nature of utility (total and marginal). Demand curves, use of indifference curves. Type of goods. Supply curves. Consumers surplus and producers surplus. Market equilibrium in supply and demand. Elasticities of demand and supply Nature of elasticities of demand and supply in case of Agriculture and forestry products as compared to other commodities. Derived demand.
2. **Factors of production:** Wages, Interest and profit. Factors affecting interest rate and wages. Production function. Types of production function Stages of production: Total product, Average physical product, Marginal physical product. Relationship between mean annual increment and current annual increment. Total revenue, average revenue, and marginal revenue. Law of diminishing marginal returns. Total cost, Fixed cost, Variable cost, average cost and marginal cost. Long and short-run cost curves. Level of production (with unlimited and limited funds). Size of firm, Factor-factor relationships Product-product relationships (competitive, complementary and supplementary). Returns to scale. Least cost combination of inputs. Relationships

between productions of timber, wildlife, forage recreation and water.

3. **Definition of isoquants, isocosts, expansion path, rates of substitution. Marginal rate of substitution**
4. **Break-even point:** Profit maximization and loss minimization concepts.
5. **Marginal cost pricing:** Price fixation consideration for price fixation, Effects of price and wage fixation in economics efficiency, Price discrimination, free competition, monopolies, monopsonies, oligopolies. Externalities (economies and diseconomies). Social costs and social returns, Justification of government run projects where large externalities are involved.
6. **Taxes:** Income tax and excise tax. progressive, proportional and regressive taxes.
7. **Planning in developing countries:** Determination of plan objectives and formulation of plans and projects.
8. **Basic statistics of forestry:** Area, Value of fixed capital, working capital and annual production. Contribution of forestry to GNP.

Recommended Books

1. Akhtar, S.M. Introduction to Modern Economics, (Latest edition) Publishers United Ltd. 176-Anarkali, Lahore.
2. Dewett, K.K. Modern Economic Theory (1987) Shyam Lal Charitable Trust, Ravindra Mansion, Ram Nagar, New Delhi.
3. Duerr, W.A. William J. Baumol and Alan S. Blinder Principles and policy (1982 (II Edition) Harcourt Brace Jovanovich Inc. New York
4. Elbert V. Bowden Principles of Economics(1983) 4th Edition South Western Publishing Co. Dallas U.S.A

1. SOCIOLOGY

I. Introduction

1. Sociology as a scientific discipline
2. Sociology and its relation with other social sciences with special reference to Rural Sociology

II. Basic Concepts

1. Society
2. Community
3. Norms, Social values Social organization

III. Culture

1. Definition
2. Material and Non-material culture
3. Growth of culture
4. Cultural conflict
5. Cultural Lag
6. Diffusion and Adoption

IV. Social Groups

1. Group composition and functions
2. Types of groups Primary & Secondary

V. Deviance and Social Control

1. Deviance and con;
2. Mechanism and technique of social control

VI. Personality

1. Foundations of human
2. Personality - Biological, cultural and social

VII. Human Relations

1. Concept and principles of human relations
2. Human Needs
3. Communication, motivation and moral building

VIII. Dynamics of Leadership

1. Concept of leadership
2. Types of leadership
3. Leadership for development administration

IX. Community Organization

1. Principles of community organization
2. Experiments in Pakistan
3. Programme planning

X. Introduction to Research

1. Basic concepts of social research

Recommended Books

1. Chiny, Eley, Society New York: Random House, 1964
2. Goode W.J. & Hatt Paul K. Methods in Social Research.

(International Student Edition) Tokyo Kogakusha Co., Ltd., Copy right McGraw Hill Inc. Co., 1952.

3. Chiney, Eley, Sociological Perspective. New York: Random House, 1963
4. Inkeles, Alex, What is Sociology. New Jersey, Prentice-Hall, 1964
5. Simpson, George, Man in Society. New York: Random House, 1964
6. Moore, Wilbert E, Social Change. New Jersey. Prentice Hall, 1963
7. Alvin L. Bertrand, Rural Sociology. New York Mc-Graw Hill Book Co. Inc. 1958.
8. Earnest B. Harper, Community Organisation in Action. New York, Associate Press.
9. Barnes, H.E. Society in Transition.
10. Lynn Smith, T. The Sociology of Rural Life
11. Everret. K. Wilson Sociology; Roles and Relationships
12. Robert Nisbet Social Change and History
13. G.Das, (1995). Principles of Sociology. King books, Educational Publishers, New Dehli.
14. Giddens, Anthony (1993). Sociology (2nd ed.) Oxford, Polity Press, Blackwell Publishers.
15. Vaunder Zender, James W. (1988). The Social Experience. An Introduction to Sociology. New York: Random House.
16. Taqa, Abdul Hameed (2000), An Introduction to Sociology, Lahore.

2. PUBLIC POLICY

I. Introduction to Public Policy

1. Public Policy
2. Introduction
3. Definitions
4. Components
5. Origin and development
6. Importance

II. Introduction to Public Administration

1. Elements of public administration
2. Scope of public administration
3. Administration of public and private sectors

III. Historical development of the stud of Public Administration

IV. Importance of personal administration

1. The concept of personal administration and management
2. Career planning in Pakistan

IV. Personal administration in Government and business organization

1. Leadership
2. Planning
3. Communication
4. Public Relations
5. Coordination

VI. Citizen and the administrator

1. The nature of public interest
2. Importance of public opinion
3. Rights and responsibilities of citizen in Pakistan
4. Essential qualities of public administrator
5. Social welfare

VII. Authority, Responsibility and Accountability

1. Functional and evolutionary schools of thought
2. Legislative executive and judicial responsibilities
3. Public accountability

VIII. Efforts towards administrative reforms in Pakistan

IX. Importance of training in administration

1. Pre-service training
2. In-Service training
3. Seminars, conferences, meetings
4. Field training

Recommended Books

1. Dimock, Marshall E. Public Administration, London, Rinehart.
2. Inayatullah and Anwar Tehmash Khan Administrator and the Citizen National Institute of Public Administration.
3. Munir Ahmad. The Civil Servant of Pakistan. Karachi: Oxford University Press
4. E.N. Cladden An Introduction to the Public Administration.
5. Pfiffner and Presthus Public Administration
6. Albers, H.H. (1961), Principles of organization and Management. New York, John Willey and Sons.
7. Clough, D.J. Concepts in Management Science, (New Dehli, Prentice Hall, 1968).
8. S.M. Haider, Public Administration and Administrative Law, Pakistan Law Times Publications, Kabir Street Uardu Bazar Lahore, 1973.
9. White, L.D. Introduction to the study of Public Administration, (New York, the Macmillan Co. 1939).
10. Wilson, Woodrow. The Study of Public Administration,

(Washington, D.C. Public Affairs, Press, 1955).

3. FOREST GENETICS

Course Outline:

1. Introduction and importance of the subject
2. Structure of chromosomes and genes
3. Concept of variability of character
4. Simple modes of inheritance
5. Sexual and asexual reproduction in forest trees
6. Tissue culture; a modern tool of propagation in forestry
7. Objectives and methods of tree breeding; basic information about selection, hybridization and Mutation Breeding.
8. Breeding of Poplar, Shisham, Accacia and Pines.
9. Seed orchards, seed collection and storage.

Recommended Books

- 1 John, H.D. and Lorin, W.R. (1985) Experiments in Plant Tissue Culture, 2nd Edition. Cambridge University Press, USA.
- 2 Singleton, W.R. (1963) Elementary Genetics, D. Van Nostrand and Co. New York.
- 3 Wright, J.W. (1976) Introduction to Forest Genetics. Academic Press New York.

4. FOREST ECOLOGY

Objective:

To give the student proper concept of the subject for practical application in modern perspective

1. Introduction to Forest Ecology, Definition, importance, need, scope and application of Forest Ecology.
2. Ecological Factors and their significance Soil, Water, temperature, light, atmospheric, topographic & biotic factors
3. Forest Types of Pakistan/World vegetation
4. Distribution, significance & Mgt. of Forest types of Pakistan, world vegetation
5. Development of Forest Vegetation
6. Dynamics of forest formation, colonization, migration, ecesis, aggregation & competition. Plant succession causes, phases and kinds of succession. Climax, preclimax, subclimax
7. Vegetation Structure

8. Ecosystem, Classification of plant communities, formation, association, associates, consociation, horizontal & vertical zonation of vegetation.
9. Application of Forest ecology/Modern concepts
10. Application of Forest Ecology in Watershed, Range Mgt., Geology & Soil Science etc, climate change, biodiversity, global warming

Recommended Books

1. *Ecology. From individuals to ecosystems. (4th ed.)*. Begon, M.; Townsend, C. R., Harper, J. L. (2006).
2. *Ecology and Field Biology. (6th ed.)*. Smith, R.; Smith, R. M. (2000).
3. The emergence of ecology as a new integrative discipline. Odum, E. P. (1977).
4. Pakistan Manual of Plant Ecology by Syed Sadruddin Hussain

5. FOREST ENTOMOLOGY

Theory

Part- 1: Morphology / Anatomy

1. Introduction to Entomology and insects
2. Main characters of phylum Arthropoda and its main classes
3. Characters of class insecta and its important orders
4. Insect metamorphosis and its type
5. Regions of insect body (head, thorax, abdomen and their segments)
6. Insect antennae and their types
7. Insect mouth parts and their types
8. Insect legs and their types
9. Insect wings and their types
10. Study of Digestive, Excretory, Circulatory, Respiratory, Reproductive and Nervous systems of grasshopper

Part-2: Insect pests and their management

Brief study on biology and control of important pests of trees as follows:

1. **Standing trees:** Pests of Poplar, Shisham, Deodar, Kail, Chir pine, Babul, Semul, Nurseries
2. **Felled trees:** Power post beetles. Bark borers, Termites.
3. **Nursery pests:** Cutworms, Cricket, Grasshoppers, Termites, Snails.
5. **Seed Pests:** Chalgoza cone borer, Walnut weevil and stored

seed pests of trees.

Part-3: Apiculture and Sericulture

1. Identification of honeybee and silkworm and their host plants.
2. Methods of rearing and economic products obtained
3. pests and diseases of honey bees and silkworm

Part-4: Insect control methods

1. Natural and applied control.
2. Methods of applied control:
3. Silvicultural. Biological, Mechanical, Physical, legal and Chemical.

Practical

1. Drawing labeled diagramme of grasshopper
2. Drawing and Labeling of different parts of grasshopper.
3. Drawing of insect pests and classifying them up to family
4. Collection, setting pinning and labeling of insects of important orders, their preservation in insect box for presentation in the examination.
5. Visits to Sericulture laboratory and honey bee farm

Recommended Books

1. Imms, A.D (1970). Text Book of Entomology. Taru Library, Suppliers; No 3643, Ill Mori Gate, New Delhi, India.
2. Matalcalf, C.L, W.P. flint and Metcalf, R.L (1979). Destructive and useful insects their Habits and Control, Taru Library, Suppliers, No.3643. Ill Mori Gate New Delhi, India.
3. Beeson, C.F.C (1961). The Ecology and control of Forest insects of India and neighboring countries. Taru Library Mori Gate, New Delhi, India.
4. Lohar, M.K (1998). Introductory Entomology Department of Entomology, Sindh Agricultural University, Tandojam, Sindh.

6. PLANT TAXONOMY

1. Principles of classification
 - i. Introduction to classification of plant kingdom
 - ii. Units of classification
 - iii. Binomial Nomenclature
2. Systems of classification
 - i. Bentham & Hookers system
 - ii. Englar & Prantle system
3. Description of families with reference to forest flora
Gymnosperms

- i. Pinaceae
- ii. Taxaceae
- iv. Cupressaceae

Angiosperms

Monocotyledons

- i. Poaceae
- ii. Palmaceae

Dicotyledons

- i. Ceasalpinaceae
- ii. Papilionaceae
- iii. Mimosaceae
- iv. Myrtaceae
- v. Oleaceae
- vi. Rosaceae
- vii. Rhamnaceae
- viii. Salicaceae
- ix. Fagaceae
- x. Moraceae

Practical:

1. Description of some plant families, illustration and their identification with the help of herbarium specimens.
2. Collection, preservation, mounting and labeling of 20 plant specimens on standard size herbarium sheets for presentation in the examination.

Recommended Books:

1. Rendle, A.B. 1952. Classification of flowering plants Vol.1&II, Camberage University, Press
2. George .H.M Lawrence, 1951. Taxonomy of vascular plants. The Mac Millan Company, New York.
3. H. Mukherji, 1954. Plant Groups (IIIrd Edition) Central Book Agency, Delhi, India.
4. Dr. Muhammad Nawaz, 1980. A text book of general botany Vol. II. Angiosperms (1). Academic Publisher, Talimi Markaz Ltd, 3 Kabir Street, Urdu Bazar, Lahore.
5. B.P. Pandey, 1980. Modern Practical Botany, Vol. II. S. Chand & Company (Pvt.) Ltd, Ram Nagar, New Delhi.
6. Muhammad Shabir Mughal, 2009. Plants of Pakistan. Pakistan Forest Institute, Peshawar.

7. FOREST ACCOUNTS AND PROCEDURE

1. **Office Procedure:** Maintenance of office records, register of books and maps, dispatch and receipt register, fire reports, drafting of letters, forms of official communications, letters, demi-official letter, memorandum, endorsement, reminder, corrigendum and executive order.
2. **Service Rule:** Government Servants Efficiency and Disciplinary Rules, 1973. Inquiry procedure. Government Servants Conduct Rules, 1964. Revised Leave Rules, 1981.
3. **Forestry Works:** Preparation of cost estimates for forestry and civil works, maintenance and disbursement of muster rolls, maintenance of measurement books, submission of completion report.
4. **Timber Accounts:** Timber Forms 5 to 17. Function of Depot Officer. Preparation of launching lists. Mooswaras and transport/transit pass and challans. Sales depot, sorting and stacking of timber and lots etc. Hammer-marking of sold timber. Rules for supply of firewood to forest officials maintenance of forest depot record.
5. **Cash Accounts:** Classification of revenue and expenditure, new accounting model, forest/cash advance, C.R.S.P., preparation of pay bills, voucher, TA bills and their disbursements, introduction of financial power and limits, instructions regarding the preparation and maintenance of Range Accounts/cash book, compilation of monthly accounts.
6. **Stores:** Procedure regarding purchase/procurement, register of stock maintenance, condemning stock items, disposal of unserviceable stores, calculation of depreciation value.
7. **Project:** Project cycle management, Planning and its process in Pakistan. Project planning, preparation, appraisal, implemental procedure, monitoring and evaluation. Introduction to PC-I, PC-II, PC-III, PC-IV and PC-V.
8. **General/Miscellaneous:** Annual plan of operation, earnest money deposits, maintenance of compensation register, Annual confidential report (ACR)/ Performance evaluation report (PER).
NB: Students will prepare a project on PC-I format.

Recommended Books

1. Ajmal, M.S. and R.M. Omer (1996). Forest Accounts and Procedures. Danishkada Publishers, Lahore. Pakistan.
2. Conduct Rules 1964.
3. Efficiency and Discipline Rules 1973.
4. Forest Manual Volume-II and III.
5. Forest Accounts Code. Vol.III.

6. Leave Rules 1981.
7. T.A. Rules 1993.
8. Hand book for DDO's Govt. of Pakistan.
9. A hand book on project management cycle Govt. of Pakistan.
10. How to supervise workers at work Govt. of Pakistan.

1. FOREST ENGINEERING – I

Course Outline:

1. Introduction

Road Management Policy; Vision for Forest Roads; Guiding Principles for Road Management; Road Density; Road Location; High-risk Sites; Economic, Efficient and Effective Road Design; Temporary Roads; Drainage of Surface Water; Fish Passage; Waste Areas; Rock Pits and Quarries; Road Maintenance; Vacating Road.

2. Forest Opening-up Planning

Public awareness of environmental questions; issue between foresters and environmentalists; improve environmental soundness and public acceptance of roads; creation of feasible alternatives; basic values guiding the acceptance of technical solutions; value-focused thinking; integration of environment and development in decision-making; comprehensive analytical procedures for prior and simultaneous assessment of the impacts of decisions; environmental impact assessment; criteria and indicators of environmental and social values; Legislative rules about environmental issues; value-focused opening-up planning; design and implementation systems; conception, realization, operation, and recycling; Forest Development Planning; key component of environmental planning and decision-making.

3. Transportation Planning

Introduction; Goals of Transportation Planning; Objectives of Transportation Planning; Levels of Planning; Transportation Planning Strategies; Vision for the Transportation System; Inventory and Current Conditions; Transportation Planning Consistent with the Planning Level.

4. Forest Road Design

Introduction; Roads Manual; Goals of Road Design; Objectives of Road Design; Road Design Strategies; Engineering Procedures; Base Level Engineering Procedures; Mid-Level

Engineering Procedures; Upper Level Engineering Procedures; Road Design Standards; Design Standards for Low Use Roads; Design Standards for Medium Use Roads; Design Standards for High Use Roads; Road Design Criteria; Coordinated Planning and Location of Roads; Reconnaissance; Road Location; Road Prism Design; Road Drainage; Surface Drainage; Subgrade Shapes; Road Grades; Drainage Structures; Running Surface; Special Drainage; Design of Stream Crossing Structures; Temporary Road Design by Timber Contractors; Road Design by Easement Holders; Road Construction; Referencing Centerline; Culvert Referencing; Cut and Fill Slopes; Landings and Turnouts; Curve Widening; Log Trucks and Yarders; Lowboy Truck and Trailer; Curve Widening Diagram; Maximum Vehicle Off-tracking.

5. Forest Road Construction

Introduction; Goals of Road Construction; Objectives of Road Construction; Road Construction Strategies; Timing; Clearing and Grubbing; Options for Disposal of Clearing and Grubbing Debris; Sidecast; Scattering; Pile and Burn; End-Haul; Chipping and Scattering; Balanced Cut and Fill (BCF) Construction; Full Bench Construction; Construction on Marginally Stable Slopes; Grading and Compaction; Subgrade and Surfacing; Erosion Control.

6. Blasting Techniques

History of Explosives; Introduction to Explosives; Basic Service Explosives & Accessories; Uses of Explosives; Calculation of Burden and No. of Charges; Types of Explosions; Preparation of Firing Circuit; Remote-controlled Blasting; Introduction to Commercial Explosives; Safety Precautions in Handling Explosives; Controlled Blasting; Controlled Demolition; Modern Trends in Explosives.

7. Forest Road Improvement

Introduction; Goals of Road Improvement; Objectives of Road Improvement; Road Improvement Strategies; Road Improvement Planning; Road Improvement Design; Development of Road Improvement Projects.

8. Project Administration for Road Projects

Introduction; Goals of Project Administration; Objectives of Project Administration; Project Administration Strategies; Knowledge, Skills, and Abilities (KSAs) for Project Administrators; Before Construction Begins; Responsibilities of Contract Administrators During Construction; Final Inspection

and Approval.

9. Forest Road Maintenance

Introduction; Goals of Forest Road Maintenance; Objectives of Forest Road Maintenance; Road Maintenance Strategies; Inventory; Inspection; Planning; Design Standards; Frequency of Maintenance; Timing; Coordination; Implementation Options; Department of Forestry and Equipment; Timber contractors; Knowledge, Skills, and Abilities (KSA's) for Maintenance Personnel; Maintenance Supervisors and Personnel; Contract Administrators (Timber Sale Contracts and Service Contracts); Documentation; Monitoring; Priority Maintenance; Road Closure Or Vacation; Maintenance Functions; Drainage Maintenance; Road Surface; Cut and Fill Slopes; Erosion Control; Vegetation Control.

10. Forest Road Vacating

Introduction; Goals of Forest Road Vacating; Objectives of Forest Road Vacating; Road Vacating Strategies; Road Vacating Assessment; Stream Crossing Excavations; Road Surface Runoff and other Drainage Structures; Treatment of Unstable Areas; Erosion and Sediment Control; Blocking the Road; Timing; Guidelines for Areas of Special Concern.

11. Conservation Ethics

Rethink, reduce, reuse, recycle; intrinsic and intangible worth of forests; valuation of human impacts on nature; restraints and imperatives of conservation; romantic and utilitarian conservation.

Recommended Books

1. Forest Engineering: Roads and Bridges by James L Harrison
Buy used
2. A Manual of Forest Engineering for India, Volume 2 by Charles Gilbert Rogers
3. Handbook of Forest Engineering
4. Engineering for forest rangers in tropical countries, with special reference to Burma, by Alan Hubert Lloyd
5. Positive Impact Forestry: A Sustainable Approach To Managing Woodlands by Thomas J. McEvoy and James Jeffords
6. Forestry Handbook by Karl F. Wenger
7. Forest Management and Planning by Pete Bettinger, Kevin Boston, Jacek Siry, and Donald L. Grebne
8. The Woodlot Management Handbook: Making the Most of Your Wooded Property For Conservation, Income or Both by Stewart Hilts, Peter Mitchell, and Ann-Ida Beck

9. Essentials of Forestry Practice by Charles H. Stoddard and Glenn M. Stoddard
10. Owning and Managing Forests: A Guide to Legal, Financial, and Practical Matters by Thomas J. McEvoy and Carl Reidel.

2. BIODIVERSITY AND CLIMATE CHANGE

Objective:

To equip the students with knowledge and importance of biodiversity and climate change and learn skills and techniques to conserve biodiversity and mitigate global warming and climate change.

Course Outline

1. Definition of biodiversity and its scope.
2. Factors affecting biodiversity of flora and fauna (human population, industrialization and unsustainable land uses).
3. Biodiversity status of flora and fauna in various zones/regions. Threatened and endangered mammals, birds, and plant species in Pakistan.
4. Biodiversity rich areas and hotspots.
5. Conservation and management strategy for biodiversity in Pakistan.
6. Ecosystem based adaptation
7. The concept of climate change and its harmful effects. Causes of climate change.
8. Climate change assessment and predictions.
9. Recommended actions to reduce global warming and climate change.

Practical

Field: Visit different sites to assess the status of biodiversity.

Filed: Visit to biodiversity conservation projects.

Field: learning various methods to reduce global warming.

Recommended Books:

1. IUCN (1996): Sarhad Provincial Conservation Strategy, Government of NWFP.
2. Khattak, A.K. (2006): Resource Management Plan for Palas Forests, Lower Kohistan Forest Division, NWFP Forest Department.

3. PARTICIPATORY FORESTRY

Objective:

It will help students to understand difference in centralized and decentralized forest management, socio-economic and ecological relationship between forests and people. It will explain students the concept, levels, and forms of peoples' participation in forest management through analysis of need dependence and traditional interactions between forests and people.

Course Outline:

Theory

Concept and scope of Participatory forest management. Traditional Centralized Forest Management. Forest Management in Pakistan. Conceptual Overview of Participatory Forest Management: Decentralization and Devolution, Participation, Terminologies for Participatory Forest Management (PFM). Review of Participatory Forest Management, Centralized vs. Participatory Forest Management. Impacts of PFM.

Participation Concept, Levels of Participation, Forms of Participation, Drives for Participation, Review of Participation in Forest Management, Factors Affecting Participation. Measuring Participation in PFM

Practical

Visits to various Participatory forest management project and note varicose characteristics of those projects, compare them and understand the difference in different participation levels and approaches used in Participatory management of forestry projects.

Recommended Books

1. ADB. (2006). *Strengthening Participation for Development Results: A Staff Guide to Consultation and Participation*. Asian Development Bank.
2. Adhikari, B., Falco, S.D., and Lovett, J.C. (2004). Household characteristics and forest dependence: evidence from common property forest management in Nepal. *Ecological Economics* 48: 245-257.
3. Agarwal, B. (2001). Participatory exclusion, community forestry and gender: an analysis for South Asia and a conceptual framework [Electronic version]. *World Development* 29:1623-1648.
4. Anderson, J. (2000). Four considerations for decentralized forest management: subsidiarity, empowerment, pluralism and social

capital. Enters, T., Durst, P.B., and M. Victor (eds). 2000. *Decentralization and Devolution of Forest Management in Asia and the Pacific. RECOFTC Report N.18 and RAP Publication 2000/1. Bangkok, Thailand.* Rome, Italy: FAO.

5. Arnstein, S.R. (1969). A ladder of citizen participation [Electronic version]. *Journal of the American Institute of Planners.* 35: 216-224.
6. Hobley, M. (1996). The New Institution. In *Participatory Forestry: The Process of Change in India and Nepal. Rural Development Forestry Study Guide 3.* Hobley, M. Ed. Rural Development Forestry Network. Overseas Development Institute, London, UK: ODI
7. Hobley, M. *Putting 'social' into forestry?* Forest Policy and Environment Programme: Grey Literature: ODI. November (2005).
8. Mamoona, W.M. (2010). Community Participation in Participatory Forest Management Programs in Azad Jammu Kashmir And Hazara's Districts of Pakistan. Unpublished doctoral dissertation, University Putra Malaysia.

4. NON-WOOD FOREST PRODUCTS

Objective:

Introduce the non-wood uses of forests for sustainable forest resource management based on multiple uses of forests

Course Outline:

1. Introduction of principal non-wood forest products
2. Introductory sericulture
3. Morphology, anatomy, and developmental physiology Silkworm
4. Silkworm rearing and diseases
5. Cocoon harvesting and Processing
6. Mulberry cultivation
7. Bee keeping
8. Management of honey bee colonies
9. Honey bee flora
10. Pest and diseases of honey bee and their management
11. Mazre, Mushroom, Resins and Gums; their utilization and economic aspects
12. Medicinal plants of Pakistan; their importance and scope
13. Cltivation, Collection and Conservation of medicinal plants

Recommended Books:

1. Atkins, E.L. and Banker, R. 1978. The Hive and the Honey bees. Dadant & Sons.
2. Ganga, G. 2003. *Comprehensive Sericulture*. Volume II: Moriculture. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
3. Ganga, G. 2003. *Comprehensive Sericulture*. Volume II: Silkworm Rearing and Silk Reeling. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
4. Howes, F.N. 1979. Plants and Bee Keeping. Faber Paperbacks
5. Fred C. Atkins 1974. Guide to Mushroom growing Faber and Faber Ltd, London.
6. M. Shabir Mughal. 1991 Monograph on *Nannorrhops ritchiana*, H. Wendl(Mazri), PFI, Peshawar.
7. Punjab Forest Leaflets No.13. Resin Tapping Instruction and Rules.
8. M. B. Zaman. 1972. Hundred drugs plants of Pakistan.
9. Dr. M Aslam Gill. 2006 Guidelines for cultivation, collection, conservation and propagation of medicinal herbs.

5. INTEGRATED LAND USE MANAGEMENT SYSTEMS**Objective:**

To educate the students about the importance of sustainable integrated land use management systems, the present management systems used by different Departments and developing sustainable integrated management systems.

Course Outline:

1. Definition and importance of sustainable integrated land use management.
2. Land management paradigm for sustainable development. Challenges and opportunities for integrated land management.
3. Land uses mapping including forests, agriculture, rangelands, waterbodies, habitations.
4. Mapping social uses of natural resources and study of demand and supply of different land uses' products.
5. Study of constraints in sustainable land uses: land tenure, poverty, conflicts in uses, administrative, technical and financial
6. Study land use planning systems adopted by different line agencies including Forest, Agriculture, Livestock, Wildlife and Fisheries Departments.
7. Policies and Laws concerning land use planning by different Departments.
8. Planning, implementing and monitoring sustainable integrated

land use management plans with participation of communities.

Practical

1. Field: Practical mapping of land uses with GPS and study of land use practices applied.
2. Field & Lab: Developing integrated land use plans with participation of local communities.

Recommended Books

1. Enemark, S. (1999): Denmark – the EU Compendium of spatial planning systems and policies. Brussels.
2. Randolph, John. (2003): Environmental Land Use Planning and Management, USA.

6. FORESTRY EXTENSION

Course outline

1. Definition of forestry extension
2. Objectives of forestry extension
3. Means and tools of forestry extension
4. Essentials for effective forestry extension
 - i) Mobilization
 - ii) Local support
 - iii) Training of local cadres
 - iv) External technical support
 - v) System management
5. Forest policy and forestry extension Programmes in Pakistan
6. Strategies of forestry extension adopted by different Departments and projects
7. Evaluation and monitoring of Forestry extension Programmes

Recommended Books

1. Bekkering, T. Naughton, G., and Werter, F. (1993): Forestry Extension in Pakistan
2. FAO-RWEDP (1988): Planning Forestry extension Programmes. Report of a Regional Expert Consultation; in collaboration with Forests, Trees and people Programme. Bangkok, Thailand.

7. INTRODUCTION TO GIS AND RS

Objective:

To acquaint students with the modern tools of GIS and RS for forest management.

Course Outline

1. Aerial Photos. Sensors, Cameras, films and filters.
2. Types of photos scale of photos. Season of photography.
3. Aerial photo interpretation techniques
4. Photo-grammetry, measurement of scale, distance, heights and slope.
5. Satellite based Remote Sensing. Sensors platforms.
6. Introduction to energy sources and radiation principles.
7. Thermal Infrared and microwave Remote Sensing.
8. Introduction to GIS
9. Spatial data
10. Georeferencing and digitizing
11. Global Positioning System (GPS)

Recommended Books

1. Paul Bolstad. 2008. GIS Fundamentals, a First Text on GIS. 3rd Edition. Eider Press.
2. Lillesand, T.M., R.W. Kiefer and J. Chipman. 2007. Remote sensing and Image Interpretation. 6th edition. Wiley and Sons.

Practical

1. Introduction to RS and GIS software
2. Georeferencing, digitizing and map making.

COMMON COURSES OF BOTH B.SC HONS AGRICULTURE (MAJOR IN FORESTRY) AND BS FORESTRY (4 YEARS) FROM SEMESTER V- VIII

ENERGY PLANTATION AND BIO-FUELS

3(2-1)

Objective:

To develop understanding regarding the prospects and possibilities of raising bioenergy plantations, bio-fuel production, and conversion technologies.

Course Outlines:

Theory

Introduction and advantages of energy plantations. Global overview of energy and biomass consumption patterns. Energy and biomass consumption patterns in Pakistan. Environmental impacts of biomass energy.

Basic concepts of forest production ecology; the biomass production potential of a forest ecosystem; production of energy wood at special short-rotation plantations; use of residual biomass from traditional forestry operations for energy; harvesting and transportation logistics of energy wood production.

A brief introduction to bio-energy conversion technologies; utilization of bio-energy with reference to the global carbon cycle and climatic change, especially with regard to CO₂ emissions and carbon storage; and the role of bio-energy in Pakistan and other countries, especially its potential for the development of rural areas.

Assessment of bio-energy programs in Pakistan. Power generation from energy plantation, biomass gasification-producer gas. High Density Energy Plantations (HDEP). Land and biomass availability for sustainable bio energy.

Bio-fuels introduction, Tree Born Oils (TBO's), potentials and advantages, bio-diesel trans-esterification, Important bio-fuel species and their silvicultural management.

Overview of the markets for wood biomass for energy production globally and within the Pakistan this includes the supply, quantity, demand, and consumption as well as consumer market aspects. Fundamentals of the policies that have impacts on the supply and consumption of the energy wood; wood based fuels; and/ or bio-energy and bio-fuels' markets

Need for research and development on environment friendly and socio economically relevant technologies. Energy from plants-problems and prospects. Petro-crops. Criteria for evaluation of different species for energy plantation.

Advanced energy technologies in the production of bio-fuels

Practical:

Identification of important fuel woods and petro-crops. Study of different properties of bio fuels used in Pakistan. Determination of calorific value, moisture and ash content in biomass. Study of energy consumption

pattern in rural and urban areas through survey. Visit to nearby Bio-energy units.

Suggested Readings

1. Donald L. Klass. 2010. Biomass for Renewable Energy, Fuels, and Chemicals. Amazon Publishers
2. Snelder, D.J. & Lasco. R. 2008. Small Holder Tree Growing for Rural Development and Environmental Services. Springer Publisher.
3. Kumar V. 1999. *Nursery and Plantation Practice in Forestry*. Scientific Publications.
4. Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors.
5. Chaturvedi AN. 1994. *Technology of Forest Nurseries*. Khanna Bandhu
6. William, B. R. & Gowen. 1994. Forest Resources and Wood based biomass. Oxford and IBH New Delhi.

2. FOREST POLICY AND LAW

3(3-0)

Objective

To develop an understanding of forest policy and forest laws.

FOREST POLICY AND LAW

Objective:

To develop an understanding of forest policy and forest laws.

Theory:

Forest Policy

Definition of Policy. Principles of policy formulation, requirements of a sound national forest policy, inter-relationship of national forest policy with other relevant policies. Linkages of forest policy with economic development, national character and modern technology. History of National Forest Policy since 1894 to to-date. Comparison of the national forest policy of Pakistan with other countries.

Forest Laws

Definition of law. Need for law. The basis of law. Necessity and limitations of a special forest law. History of Forest Laws in Indo-Pakistan.

Definition of common legal terms:

Abetment, Adverse possession, Bail, cattle pound, cognizable and non-cognizable offences, collusion, compounding an offence, Confiscation, Confession, Criminal breach of trust, criminal misappropriation, criminal trespass, easement, Escheat, Evidence, Forfeiture, Inter-mission, Interruption, Leading question, Mischief, Mistake of law, Mistake of fact, Pre-emption, Recognizance, Reanullius: Right, Royal tree, Salvage, Search Warrant, Seizure, Servitude, Summary trials, Summons, summon cases Treasure trove, Warrant cases, waif wood, wasteland.

Acts, Regulations, Ordinances and Rules:

Study of Salient Features of following:

1. The Forest Act, 1927
2. The Baluchistan Forest Regulation. 1880
3. Guzara rules of Rawalpindi District, 1927
4. Cattle trespass Act, 1871
5. Sind grazing rules, 1936
6. NWFP(KP) Forest Ordinance 2002
7. The Jammu & Kashmir Forest Regulation 1930.
8. The Gilgit Forest Rules 1932
9. West Pakistan Wildlife Protection Rules, 1960.
10. Punjab Fisheries Act, 1914.
11. Choas Act, 1900

Recommended Books:

1. Abeerullah Jan (1991) Forest Policy Ministry of Food and Agri, Government of Pakistan.
2. Asif Jah 2009 Explanatory Notes on Forest Law with up-to-date amendments. Compiled for the use of Forestry students at Pakistan Forest Institute Peshawar.
3. F.A.O. Forest Policy, Law and Administration F.A.O. Rome. Government of West Pakistan 1958.
4. West Pakistan Forest Manual Vol.I Govt. of Pakistan (1975)
5. Forest Policy Directives Ministry of Food and Agri. Government of Pakistan.
6. Forest Act, 1927 Ideal Publisher, Karachi Forest
7. NWFP (KP) Forest Ordinance 2002
8. McDermott, C., B. Cashore & P.Kanowski. 2009. Global

Environmental Forest Policies: An International Comparison.
Earthscan.

3. WOOD SCIENCE AND TECHNOLOGY 3(2-1)

Objective:

To educate and train the students in forest products research.

Course Outlines

1. Structure of wood: wood definition, process of wood formation, anatomical properties, anisotropic structure of softwoods and hardwoods. Description of wood elements in three dimensions. Definition of related terms helpful in identification of Pakistani timbers.
2. Defects in wood: definition, kinds and classification of natural defects, cause of development of natural and drying defects during seasoning process.
3. Wood properties: definition of physical and mechanical properties, colour, luster, odour and taste, density wood-moisture relationship, shrinkage and swelling, electrical and thermal conductivities, calorific value, static bending, compression, tension, hardness, shear, impact bending, cleavage, nail/screw holding power. Applications of mechanical properties for various purposes, timber connectors and their types.
4. Wood seasoning: definition, preliminary techniques, timber storage, orthodox / non-orthodoxal methods of wood drying, different stacking methods, moisture content and its determination methods, recent developments in lumber drying, measurement and control of various drying defects and their control, economics of different wood seasoning methods.
5. Wood preservation: definition, natural durability of wood, agencies of wood deterioration, types of preservatives absorption and retention of preservatives, control of biological agencies by preservative treatment, fire retardants, their types and application methods.
6. Sawmilling and wood working: various types of sawing machines operation and maintenance, design and layout of portable sawmills, common hand tools and wood working machines, their uses and maintenance, design and layout of modern wood-

workshop, types of wood work, joints and their applications in wood work, machining properties of Pakistani timbers.

7. Pulp and paper: characteristics and classification of important fibrous raw materials, essential requirement of raw materials for pulp and paper manufacture, distribution and supply of raw material in Pakistan, chemistry and technology of various pulping and bleaching processes, consumption of paper and its products in Pakistan, future of paper industry in the country, current supply and demand of paper including import and export, brief description of paper manufacture.
8. Composite wood products: Basic theory of adhesion and cohesion as influenced by physical factors, wood adhesives; their formulation, characteristics and uses, impregnation of wood with resin forming chemicals, properties of impregnated wood, production, properties and uses of impregnated timbers, laminboard, chipboard, fiberboard, veneer cutting and peeling properties of local timbers, principles involved in the manufacture of plywood, advantages of plywood over solid wood construction.
9. Uses of woods: suitability of timbers for different uses, specialized, constructional, structural and decorative uses of Pakistani timbers.
10. Utilization of wood waste and integration of forest industries: what is waste? Types of wood waste, wood waste and its utilization, what is an industry? Principles of integration of forest industries, economic and technical advantages.

Practical

1. Studying gross features of wood.
2. Observation of wood elements in three dimensions under microscope.
3. Determination of physical properties.
4. Testing of timbers for different mechanical properties.
5. Demonstration of stacking techniques and measurement of seasoning defects.
6. Demonstration of various methods of wood preservation.
7. Manufacturing, testing and evaluation of plywood, particleboard, MDF etc.
8. Measurement of round and sawn timber.
9. Calculation of recovery of converted timber.

Recommended Books

1. Bower, L.J. 2003. Forest Products and Wood Science; An Introduction. 4th Ed. Wiley-Blackwell
2. Desch, H.E. and J.M. Dinwoodie. Timber its' structure, properties and utilization. 6th edition published by the Macmillan Press Ltd. London (1983).
3. Dinwordie, J.M. 1981. Timber, its nature and behaviour. Van Nostrand Reindold Co., New York.
4. Editorial Board, Forest Research Institute and College Dehra Dun. Indian Forest Utilization; Vol. II published by the Manger of publications, Dehli, 1972.
5. Evans, Julain (ed.). 2008. The Forests Handbook. Wiley Blackwell.
6. Grant, J. Wood, Pulp and Allied Products London Leonard Hill, Ltd., 1947.
7. Haygreen, John G. and Jim L. Bowyer. Forest Products and wood science, 2nd. Edition published by Iowa State University Press/Ames 1989.
8. J.G. Wilkinson. Industrial Timber Preservation, published by Associated Business Press, London. 1979.
9. J.L. Backrich. Dry Kiln Handbook, published by H.A. Simons (International) Ltd. Vancouver, B.C. Canada.
10. Kollmann, Franz, F.P. and Wilfred A. Coe, Jr. Principles of Wood Science and Technology Vol. I & II, Solid Wood. Published by Springer-verlag Berlin, W. Germany, 1968.
11. Mehta T. 1981. A hand book of Forest Utilization. International Boode Distributor, Dehra Dun, India.
12. Sjostrom E. 1981. Wood Chemistry-Fundamentals and Applications. Academic Press, London.
13. Torgovnikov, G.I. 1993. Dielectric Properties of Wood and Wood based Material. Published by Springer NY.
14. Walker, J.C.F. 1993. Primary Wood Processing; Principles and Practices. Chapman and Hall. NY.
15. Brown, N.C. Lumber, New York; Wiley, 1950.

4. FOREST SURVEY AND LEVELING

3(2-1)

Objective:

To impart basic knowledge to forestry students of surveying for making forest road and buildings.

Theory:

1. Introduction: Definition, objectives, Principles and classification of survey.

2. Scales and their classification. Construction of scales and their usage.
3. Triangulation Survey: Use of survey instruments. Adjustment of chain/measuring tape. Selection of base line and formation of best and well conditioned triangles in the field. Offsetting and its classification. Area calculation through triangulation. Use of GPS and its application for area calculation. Data recording in Field Book and plotting of survey.
4. Traverse Survey: Use of Prismatic and Surveyor's compasses for taking Reduced and Whole circle bearings for an open and closed traverse. Calculation of angles from bearings. Magnetic declination and Dip. Effect of local attraction on bearings. Plotting of Traverse and distribution of closing error.
5. Plane Table Survey: Instruments and their use. Various methods of Plane Tabling. Location of observer's position by three point's problem. Contouring: Contour lines; vertical and horizontal equivalent. Methods of locating contour lines in the field through direct and indirect methods. Plotting of contours on ground and on sheet.
6. Leveling: Bench marks and their classification, Leveling instruments: dumpy level. Automatic Level, Theodolite, Leveling staff and its reading. Methods of leveling: simple, compound, flying and reciprocal leveling. Level book and its recording. Profile and Cross-section leveling and their plotting for a forest road.
7. Areas and Volumes: Calculation of areas and volume by various methods.
8. Use of Minor Instruments: Use of Abney level, hand level, tangent clinometers, spirit level, proportional compass, and planimeter,

Practical:

1. Practice in: Chain Survey. Compass survey. Plane table survey. Longitudinal and cross sections of road.
2. Survey drawings: At least four survey drawings of the above exercises will be prepared by each student of which one will be in ink and colour.
3. Practical exercises in road alignment.

Recommended Books

1. Barry, F., S. J. Kavanagh and G. Bird. 2000. Surveying: Principles and Applications.
2. Paul, A. Z. 1997. Surveying Principles for Civil Engineers.
3. Kanetkar. 1956. Surveying and leveling, Part I & II A.V. Griber, Prakashan, Pona-2, India.
4. The Punjab Govt. (1955). Rasul Manual for subordinate Engineers,

5. SILVICULTURE-I

Objective:

To acquire knowledge and skills of growing and managing forest trees.

Theory

Introduction of Silviculture and its definition. Role of Silviculture in forest resource management. Concept of forest, classification of forests, including major divisions of the world's forest. Forest types of Pakistan and their distribution. Forest composition, stand structure and tree classification, pure and mixed stands, even and un-even aged forest stands their characters and development, advantages and disadvantages. Tree growth: stem development, growth rings, spiral grains, reaction wood and wood quality. Shoot development, crown shapes, and their development. Tree reproduction: flowering habit of trees, maturity in trees, seed periodicity, factors influencing periodicity, flower initiation and cone development in conifers, flowering in deciduous trees, induced seeding. Root growth: rooting characteristic, environmental effects on development, mycorrhiza. Forest site: soil formation, soil profile, site quality and its evaluation. Stand density: methods for determining stand density.

Recommended Books:

1. Champion, H.G., S.K and G.M.Khattak, 1965. Forest types of Pakistan. Pakistan Forest Institute, Peshawar.
2. Chamption, H.G., S.k. Seth and G.M.Khattak. 1965. Manual of Silviculture for Pakistan. Pakistan Forest Institute, Peshawar.
3. Daniel, T.W., J.A.Helms and F.S.Baker, 1979. Principles of Silviculture (2nd edition). McGraw-Hill Book Company.
4. Siddiqui, K.M. 1997. Forestry and Environment. Pakistan Forest Institute, Peshawar.
5. Siddiqui, K.M. 1997. General Silviculture. Pakistan Forest Institute, Peshawar.
6. Dvorak, J. and L. Novak. 1994. Soil Conservation and Silviculture. Elsevier Science.
7. Smith, D.M. (1987). The Practice of Silviculture. 7th Ed. John Wiley & Sons, New York.

6. FOREST ENGINEERING-II

Part-I (Building Materials)

1. Stones and Bricks: Common varieties and characteristics of building stones. Crushed stones, natural gravel and sand. Types and characteristics of good bricks.
2. Mortars: Lime and cement mortars; preparation, properties and uses.
3. Concrete: Proportioning of materials. Aggregates, water cement ratio. Shuttering, reinforcement (R.C.C.), placing and curing
4. Paints: Uses and types. Varnishes and polishers

Part-II (Building Construction)

1. Site and Foundations: Selection of site, sources of water and approach road. Object, types and design of foundations.
2. Roofs, Floors, and Joinery: Types of roofs, Beams and trusses coverings. Flat roof.
3. Brick, concrete and mosaic floors.
4. Parquetting. Joinery frames. Types of doors, windows and ventilators.
5. Fly and mosquito proofing.
6. Sanitation: Water supply and sanitary fittings. Water storage tank, septic tank, soakage pit and flue trap. Drains and manholes.
7. Finishing: Pointing, plastering, white and colour washing, distempering, painting and polishing
8. Building Estimates

Recommended Books

1. Deshpande, R.S. (1978). A Treatise of Building Construction. United Book Corporation, Poona, India.

Note: *Each student is required to submit the drawings and estimates of a small building.*
Job Assignment: Lay out of a small building. Prepare a detail estimate of a small building.

1. FOREST MANAGEMENT

Objective:

To impart knowledge and skills to the students about techniques for sustainable management of forest resources to achieve desirable forest production.

Course Outline

Theory:

1. Introduction: Definition, history and scope of forest management in Pakistan. Objectives of forest management. Forest Policy objectives in relation to national economic objectives. Peculiar features of forestry in relation to other enterprises. Integrated resource management. Management of non-timber products.
2. Rotation: Concept of rotation in regular and irregular forests. Types of rotation, choice of rotation. Factors determining length of rotation.
3. Site Quality: Significance in forestry. Estimation of site quality: a) Indirect methods: Over story interspecies relationships, ground flora / lesser vegetation characteristics, topographic, climatic and edaphic factors. b) Direct methods: Historical yield record, stand volume data, periodic height growth data.
4. Stand Density Determination: Methods for determining stand density. Methods of evaluation.
5. Increment: Concept and significance, nature and component of increment: CAI and MAI, Age of maximum volume production. Increment determination methods.
6. Normal Forest: Concept of normality in even aged forest: Normal series of age gradation/age classes, normal increment, normal growing stock and their determination, Relationship between normal volume and normal Increment and Flury's Constant. Concept of normality in uneven aged forest: normal distribution of trees of all ages per unit area and normal size class distribution. Concept of normality in Pakistani forestry.
7. Silviculture Systems and their application in Pakistan. Introduction, definition and concepts. Execution advantages and disadvantages. Applicability of the following silvicultural systems in Pakistan.
 - i- Clear felling system
 - ii- Shelterwood system
 - iii- Coppice system
 - iv- Selection system
 - v- Accessory system
 - vi- Silvicultural systems for Mazri and Ephedra forests.

8. Contemporary Resource Management Approaches (Participatory, Integrated, Joint management approaches)
9. Sustained Yield: Definition and concept of sustained yield. Types of sustained yield: Integral, Intermittent, and Annual. Objects of sustained yield. Economic aspects of obtaining sustained yield. Current status of sustained yield in Pakistan.
10. Yield and its Regulation: Objectives of felling. Methods of yield regulation:
 - i- Area Method: Control by silvicultural and other felling rules. Control by area.
 - ii- Area, Volume, and Increment method: Fixed, Revocable, Single/Floating Periodic Block Methods. Regeneration Area Method (French method by using Melard and Cotta's formulae).
 - iii- Volume and Increment Methods: Austrian, Hundeshagan's and Von Mantel's Formulae. Masson's Ratio. Modification of Von Mantel's formulae (Blandford and Simmons Method).
 - iv- Regulation of yield in uneven aged forest by using: Brandis Method, Method of control, Residual Growing Stock Method and Current Growth Method.

Note: *Working plans of Hill Forests, Riverain Forests and Irrigated Plantations be referred for yield and its regulation.*

- v- Forest organization. Legal classification: Reserved, Protected, Guzara and Unclassed Forests. Territorial classification: Block, compartment, sub- compartment. Administrative (Organizational) classification: IGF, CCF, CF, DFO, Sub-DFO/ACF, RFO, Block Officer (Forester), Beat Officer (Forest Guard). Management (Silvicultural) classification: Working circle, felling series, coupe, cutting section, periodic blocks, felling cycle, felling series.
- vi- Preparation of Working Plans: Objectives and scope of working plans. Pc-I schemes. Period of working plans. Preliminary working plan report. Format of existing working plan. Annual plan of operations. Preparation of working plans

11. Forest fires and their control. Forest fires as management tool.

Practical

Visit to different forest types of Pakistan for studying the management practices.

Recommended Books

1. Higman. S., J. Mayers S. Bass., N. Judd. And R. Nussbaum. 2004. The Sustainable Forestry Handbook. Earthscan.
2. Champion, H.G., S.K. Seth and G.M. Khattak (1965). Forest Types of Pakistan. Pakistan Forest Institute, Peshawar.
3. Clutter, J.L. J.C. Fortson et al. (1982). Timber Management: A Quantitative Approach. John Wiley and Sons. Inc. NY. USA.
4. Davis, K.P. and R.N. Johnson (1987). Forest Management. McGraw Hill Book Co., New York.
5. Khattak, G.M. (1973). Forest Management. Ferozsons, Peshawar.
6. Leuschner, W.A. (1984). Introduction to Forest Resource Management. John Wiley & Sons. Inc. NY, USA.
7. Osmonston, F.E. (1968). The Management of Forests. George Allan and Unwin Ltd. London.
8. Ram Parkash. (1986). Forest Management. International Book Distributors. Dehra Dun, (India).
9. Singh, S.P. and Singh J.S. 1992. Forests of Himalaya. Nainital, Gtanodaya Prakashan.
10. Khattak, G.M. and S.K. Khanzada. (1977). The Forest Working Plan. Pakistan Forest Institute, Peshawar.

2. WATERSHED MANAGEMENT

Objective:

To introduce basic concepts of Watershed Management and applications'.

Theory

1. Introduction to Watershed Management
Definition, importance, need, scope and application of Watershed & Watershed Mgt. The Hydrologic Cycle
2. Precipitation
Definition, formation & types of Precipitation, measurement of Rain & Snow
3. Influence of Vegetation on Precipitation
Influence on formation, interception and redistribution of precipitation
4. Run-off and its components
Types of run-off, factors affecting the runoff, infiltration & percolation, various forms of soil moisture, measurement of

Runoff

5. Evapo-transpiration
Definition, meteorological factors effecting the evapo-transpiration, measurement of evapo-transpiration(ET)
6. Erosion and Sedimentation
Definition, Types of erosion & factors effecting erosion, Hydric erosion, sediment movement & deposition
7. Soil Conservation in Watershed Mgt.
Managing watershed range & crop lands, biological and structural soil conservation measures
8. Modern concepts in Watershed Mgt.
Participatory & integrated watershed Mgt., Watershed planning, climate change, watershed Mgt. for sustainable livelihood etc.

Practical

1. Calculation of mean precipitation in a watershed by different methods
2. Determination of features of Watershed: Drainage density, Mean elevation, Area, Drop per Kilometer & Mean slope

Recommended Books

1. Sech. T.V. 2002. Principles of Water Resources. John Wiley & Sons.
2. Shah, B.H. and B. Heusch, (1991). Design of Soil Conservation Works in Watershed Areas. Pakistan Forest Institute, Peshawar.
3. Tennyson, L.C. (1986). Principles of Watershed Management. FAO PAK/78/036 Field Document No.9. Pakistan Forest Institute, Peshawar.
4. Quraiushi, M.A.A. and M. Tahir Siddiqui. 2001. Manual for Watershed Management., UAF, Faisalabad.
5. Quraiushi, M.A.A. 2002. Watershed Management in Pakistan. UAF.
6. ICIMOD. 2007. Good Practices in Watershed Management, Lessons Learned in the Mid Hills of Nepal. ICIMOD.

3. RANGE MANAGEMENT

Objective:

To introduce basic concepts of rangelands, its importance and management

Theory:

1. Introduction. Definition and importance of Rangeland and Range resources of Pakistan (Description, distribution, status, constraints etc.)
2. Principles of Range Management: Proper stocking and their

distribution (kind, number) and season of grazing.

3. Grazing effects on plant morphology and physiology.
4. Range vegetation analysis.
 - a. Basic Concepts: Animal unit (AU), Animal Unit Month (AUM), Range Frequency, Range Trend, Frequency of use, Intensity of use. Vegetation Preference.
5. Measurement of Vegetation: Estimation of grazing/carrying capacity. Range condition, range trend and range utilization. To Grazing Systems: Seasonal/yearlong grazing. Rotational grazing. Deferred grazing. Deferred-rotational grazing. Rest-rotation grazing. Nomadic and semi-nomadic grazing. Integrated range land management.
6. Range Improvement Techniques: Importance of range improvement. Artificial reseeding. Site selection. Seeding methods. Calculation of seed rate for artificial reseeding. Water Development. Water spreading. Sand dune fixation. Salting. Fencing. Herding. Range fertilization. Control of undesirable and poisonous plants.

Practical

1. Lab: Introduction to use of instruments for range vegetation analysis.
2. Identification of range plants.
3. Germination tests.
4. Field: Estimation of grazing/carrying capacity, cover, frequency, density, range condition, range trend and range utilization.
5. Visit to selected range areas and compilation of reports.

Recommended Books

1. Vallentine, John, F. 2000. Grazing Management. Academic Press (Elsevier Science & Technology Books).
2. Holechek, J. et al., 1989. Range Management, Principles and Practices. Prentice Hall, Inc. Newberry. USA.
3. Quraishi, M. A. A., G.S. Khan and M. S. Yaqoob. 1993. Range Management in Pakistan. University of Agriculture, Faisalabad.
4. Mohammad, N. 1989. Rangeland Management in Pakistan. NARC Published by ICIMOD.
5. Stoddard, L.A., A.D. Smith and T.W. Box. 1975. Range Management. McGraw Hill Book Co., New York.
6. Quraishi, M.A.A., M. Ishaque, 1995. Practical Manual of Range Management, University of Agriculture, Faisalabad.
7. Heady, H.F. 1975. Rangeland Management McGraw Hill Book, New York.
8. Ashfaq, R.M. and S.M. Rafique 1999. A guide to range analysis. Pakistan Forest Institute, Peshawar.

9. Sampson, A.W. 1962 Range Management Principles and practices. Third Edition John Wiley and Sons. Inc. New York.
10. Jerry L. Holechek, Rex D. Pieper and Carlton H. Herbel 2003. Range Management Principles and Practices. Fifth Edition.
11. Blanchet, K.H. Moechnig and J.D Hughes 2003. Grazing Systems Planning Guide University of Minnesota Extension Service, USA.

4. WILDLIFE MANAGEMENT

Objective:

To acquaint the students with the knowledge and skills needed for the conservation of wildlife and allied resources.

Course outline

Theory:

1. Wildlife: Definition and values, ecosystem concept, characteristics and management requirements for different ecosystems in Pakistan.
2. Population Dynamics of Wildlife
3. Wildlife Health: Wildlife handling, diseases, parasites and preventative management actions.
4. Principles of Wildlife Management.
5. The Wildlife of Pakistan, its distribution, status and importance.
6. Wildlife Laws and Regulations.
7. Protected areas: Wildlife Sanctuaries, National Parks. Game Reserves and Community Controlled Hunting Areas.
8. Study of endangered species as listed in CITES, IUCN Red Data Book and species listed as threatened under provincial legislation.
9. Preparation of wildlife Management plans: Purpose, structure, contents and reviews/approval procedures.
10. International treaties and conventions on biodiversity, illegal trade of wildlife.

Practical

1. To identify different important Wildlife species on the basis of specific taxonomic characteristics.
2. To prepare and submit Model Wildlife Management Plan.
3. Assignments on wildlife survey techniques (identification, counting from various direct and indirect signs).
4. Field tour: Visit to a protected area to review its management and prepare case studies.

Recommended Books

1. Sinclair, Anthony R. E.; Fryxell, John M.; Caughley, Graeme,

2009. Wildlife Ecology, Conservation and Management. Wiley Blackwell. Fulbright, Timothy E. 2007. Wildlife Science. CRC Press. UK
2. Bailey, J.A. 1984. Principles of Wildlife Management. John Wiley & Sons. Inc. USA.
 3. Giles, R.H. Jr. 1987. Wildlife Management. W.H. Freeman & Co. San Francisco.
 4. Robinson, W. L and Eric, G. Bolen. 1984. Wildlife Ecology & Management. McMillan Publishing Co. New York.
 5. Quraishi, M.A.A., R.A. Khan and Sh. M.A.Q. Hussain. 2002. Practical Manual of Wildlife Management. University of Agriculture, Faisalabad.
 6. IUCN, Pakistan (1996). Management Conflicts in Protected Areas. IUCN.
 7. McNeely, J. (1997). Conservation and the future Trends and options towards the year 2025. IUCN H.Q. pp. 119.
 8. Provincial Wildlife Acts and Ordinances. (Provincial Wildlife Departments).
 9. Quraishi, M.A.A. Rashid A. Khan. 2002. Manual for wildlife management. UAF, Faisalabad.
 10. Sale J.B (1988). Manual of Wildlife Techniques for India. Special publication of the Wildlife Institute of India.
 11. Rao, A.L. (1984). The Wildlife Legislation of Pakistan M.Sc. Thesis. University of Edinburgh. National Council for Conservation of Wildlife, Islamabad.
 12. Roberts. T.J. (1991). The Birds of Pakistan (Vol. I & II). Oxford University Press.
 13. Roberts. T.J. (1977). Mammals of Pakistan. Oxford University Press.
 14. Scott et al. (1995). Conservation of Biological Diversity; Perspectives and the future for the Wildlife Profession. Wildlife Society Bulletin 23(4): 645-657.

5. FOREST BIOMETRICS

Objective:

To acquaint with techniques and methods of measuring tree dimensions.

Course Outline

Theory:

1. Introduction and scope.
2. Individual tree measurements.
 - i) Diameter at Breast Height Point and its significance. Instrument and its use: Calliper and Tapes.

- ii) Height m Instrument and its use
- iii) Tree Age: By record, ocular estimation, by counting whorls, annual rings. Use of Pressler's borer.
- iv) Crown parameters
- iv) Form factor: Concept and use.

3. Volume Measurements: Standing tree volume and felled tree volume.
 - a) Kinds of Felled Material: timber (in round and converted form) and small wood.
 - b) Measurement of log volumes by Huber's, Smalian's, Prismoidal and Quarter girth formulae.
 - c) Stacked Wood Measurement: Stacked volume versus solid volume. Conversion of stacked volume to solid volume or to weight.
 - d) Measurement of Bark thickness and Bark Volume. Use of bark hammer and bark gauge.
 - e) Measurement of converted and sawn timber. Timber calculations. Log-Rules.
4. Introduction of volume and yield tables. Preparation and Application for determining site quality, volume and increment of a forest stand.
5. Sampling: Objectives. Full enumeration and partial enumerations. Stand and stock tables. Sample plots with fixed area and horizontal point sampling. Increment concept.
6. Tree biomass estimation and biomass expansion factors
8. Carbon stocks estimation.
9. Site Index. Significance in forestry. Determination of site Index by using guiding curve methods and growth models.
10. Miscellaneous Items: measurement of charcoal.

Practical

1. Diameter and Height measurement of standing and felled tree.
2. Volume and biomass calculation of single tree and forest stand.
3. Case study of given site for inventory.
4. Data compilation, analysis and plotting (Construction of Height-Diameter-Age curve, Data processing of fixed area plots, Data processing of Horizontal Point Sampling)
5. Increment calculations (Single tree/stands).

Recommended Books

1. Mandallaz, D. 2007. Sampling Techniques for Forest Inventories. Chapman and Hall Publishers.
2. B. Hunsch. T.W. Beers. And J. Kershaw. 2003. Forest

- Mensuration. (4th edition) John Wiley & Sons.
3. Ashraf, M.M. and I. Ahmed. 1994. Handbook of Forestry. PARC. Islamabad.
 4. Hassan, A. 1996. Elements of Forest Mensuration. PFRI. Faisalabad.
 5. Husch, B. Miller, G.I. and Beers, T.W. (1982). Forest Mensuration (Third Edition). John Wiley and Sons, New York.
 6. Avery, T.E. and Burkhart, H.E. (1994). Forest Measurements. McGraw Hill Book Co., New York.
 7. FAO (1981). Manual of Forest Inventory FAO, Forestry paper 27.
 8. Hunsch, B; Miller, G.I. and Beers, T.W. (1982). Forest Mensuration (Third Edition). John Wiley and Sons. New York.
 9. Hussain, R.W. and M.I.Sheikh (1988). A guide book for Forestry Research, PFI, Peshawar.
 10. Harlow, M. & Harrar S. 1991. Text Book of Dendrology. McGraw Hill Book Co., New York.

1. ECOTOURISM AND PARK MANAGEMENT

Objective:

To impart the knowledge of eco-tourism and park management.

Theory

Ecotourism

1. Concepts of tourism, nature based tourism and sustainable tourism.
2. Ecotourism Resources: landscapes, endemic or rare flora and fauna.
3. Effects of tourism on plants and animals population
4. Economics of eco-tourism
5. Ecotourism Services: transportation, food, lodging, guiding and interpretation services which cause minimal damage to the biological and cultural environments and promote a better understanding of the natural and cultural history of an area.
6. Developing and execution of plans for eco-tourism under different conditions.

Park Management

1. Introduction: Definition, Importance of recreation, Factors influencing recreation.
2. Forests as outdoor recreational areas. Significance of Parks. Study of important National Parks of Pakistan.
3. Development of Facilities: Camp Ground, Picnic areas, Organized camps and Interpretative facilities.
4. Duties of Park Manager.
5. Landscaping, Plant material for landscaping. Introduction to arboriculture. Propagation of plants. Nursery practices and management. Protected areas systems.

Recommended Books

1. Honey, M. 1999. Ecotourism and Sustainable Development, Island Press, Washington DC, USA.
2. Adventure Foundation Pakistan (2004): Support to Promotion of Eco-tourism, Initiatives by Palas Conservation and Development Project (Consultancy No. 53), Pattan, Distt. Kohistan.
3. Brockman C.F. and Merriam (1973). Recreational Use of Wildlands. McGraw Hill Book Co. New York.
4. Douglas, R.W. (1975). Forest Recreation. Pergamon Press Inc. New York.
5. Shaukat and M.I. Sheikh (1986). Manual for Landscape Horticulture, PFI, Peshawar.

2. FOREST RESOURCE ECONOMICS

Objectives:

To equip with the technique of valuation of goods and services not passing through regular markets.

Theory:

1. Special characteristics of forest economics. Value (Total and Marginal). Demand & Supply chain. Elasticities of demand and supply.
2. Grading of goods: inferior and normal.
3. Valuation of Forest products and services.
4. Discounting and Compounding. Present worth of annuity, Methods of depreciation: straight-line method, declining balance method.
5. Determination of economic rotation age.
6. Introduction to Location theory: Marketing transportation and other considerations.
7. Concept of World Trade Organization (WTO) in relation to forest products trade.
8. Forests Certification.

Recommended Books

1. Ruth, N. and M. Simula. 2005. Forest Certification Handbook. Earthscan Forestry Library Press.
2. Klemperer, K.D. 2003. Forest Resource Economics and Finance. Blacksburg, USA
3. Akhtar, S.M. An Introduction to modern Economics, Publishers United Ltd. 176-Anarkali, Lahore.
4. Champan, N.N. & W.H. Meyer Forest Valuation (1949) McGraw Hill Book, New York.
5. Davis, K.P. Forest Management (1966) McGraw Hill Book Co. New York.
6. Leuschner, W. A. Forest Resources Management Jhonn Wiley and Sons, New York.

3. SILVICULTURE II

Objectives:

To increase the comprehension of advanced Silvicultural techniques and implementation.

Theory

Regeneration: Definition, importance and types. Natural regeneration: factors affecting, natural regeneration, reproduction methods under

various Silvicultural systems and their applications, tending operations.
Artificial regeneration: definition, objectives, choice of natural/artificial regeneration,
silviculture of forest tree species, choice of species, local and exotic species, evaluation of site for planting, site preparation, sowing and planting methods, spacing, irrigation, cultural operation, protection.
Seeds: seed collection and extraction, seed testing, storage, pre-sowing treatments.
Nursery establishment: Objectives, types of nurseries, selection of site, layout, area preparation, growth medium/soil preparation, soil and seed treatments, manuring and fertilization, cultural operations, grading, transportation.
Desertification: causes, impacts and control. Afforestation of special sites; arid and semi-arid areas, water logged and saline areas, canal side, highways/road sides, sand dunes, land slips, denuded hill slopes and ravine lands.
Forest fires: Causes, prevention and control measures.
Forest protection against various biotic factors.

Recommended Books:

1. Ralph, D. N. 2007. Silviculture: Concepts and Applications. Waveland Press. McGraw Hills Forestry Series.
2. Champion, H.G., S.K. Seth and G.M.Khattak, 1965. Forest types of Pakistan. Pakistan Forest Institute, Peshawar.
3. Champion, H.G., S.k.Seth and G.M.Khattak. 1965. Manual of Silviculture for Pakistan. Pakistan Forest Institute, Peshawar.
4. Daniel, T.W., J.A.Helms and F.S.Baker, 1979. Principles of Silviculture (2nd edition). McGraw-Hill Book Company.
5. Siddiqui, K.M. 1997. Forestry and Environment. Pakistan Forest Institute, Peshawar.
6. Siddiqui, K.M. 1997. General Silviculture. Pakistan Forest Institute, Peshawar.
7. Dvorak, J. and L. Novak. 1994. Soil Conservation and Silviculture. Elsevier Science.
8. Smith, D.M. (1987). The Practice of Silviculture. 7th Ed. John Wiley & Sons, New York.

DETAILS OF COURSES SPECIALIZATION IN FORESTRY

Note: *One of the specializations to be opted from the 13 specialization courses given below:*

1. FOREST MANAGEMENT

(Specialization FM-I) Forest Inventory Techniques

Objective:

To equip students with modern technique of forest sampling, collection of data on sample plots and analysis of data with computer and development of volume and yield tables.

Course Outline:

1. Concepts and application of different forest sampling techniques (random, cluster, stratified) and lay out of sample plots:
 - i. Fixed area plots (square, round, 3P)
 - ii. Point sampling (Prism and Relascope)
2. Cost and time effectiveness of different forest sampling techniques and their application in different forest types and forest stands.
3. Developing models of relationship of trees for different species and site qualities:

a)	Height	-	dbh
b)	Height	-	age
c)	dbh	-	age
d)	Volume	-	dbh
e)	Volume	-	age
f)	Increment	-	dbh
g)	Increment	-	age
4. Manual data processing and use of computer for data processing of stand and stock and increment tables.
5. Development and application of volume tables and yield tables.

Practical

1. Field visit to test different forest sampling techniques.
2. Lab: Processing of forest inventory data manually and with computer.

Recommended Books:

1. FAO (1981). Manual of Forest Inventory FAO, Forestry paper 27.
2. Husch, B., Beers, T.W., and Kershaw, J. A. (2003): Forest Mensuration (4th Edition, John Willey and Sons Inc. NJ, USA.
3. Khattak, A. K. (1992): Development of Model Forest Management Plan for the Panjul Forest in Western Himalaya (Pakistan). L.W.F, L.M.U, Munich, Germany.
4. Loetsch, F.L., Zoehrer, F. and Haller, K.F (1973): Forest Inventory, Vol- II, Munich, Germany.
5. Mandallaz, D. 2007. Sampling Techniques for Forest Inventories. Chapman and Hall Publishers.

(Specialization FM-II) Stand Level Planning**Objective**

To equip students with stand level planning of forest resources.

Course outline

1. Concept of stand level planning of forest resources.
2. Advantages of stand level planning as compared to compartment level planning.
3. Criteria applied in stand level planning (Species composition, age stocking, slope, social uses).
4. Delineation of stands on maps and recording data of stands
5. Development of stand level management plans.
6. Implementation and monitoring of stand level forest management plans.

Practical

1. Field visit to forests and demonstration of delineation of stands on maps and recording various characteristics of stands.
2. Lab: Developing stand level management plan for forests.

Recommended Books:

1. Higman. S., J. Mayers S. Bass., N. Judd. And R. Nussbaum. 2004. The Sustainable Forestry Handbook. Earthscan.
2. Husch, B., Beers, T.W., and Kershaw, J. A. (2003): Forest Mensuration (4th Edition, John Willey and Sons Inc. NJ, USA.
3. Khattak, A. K. (1992): Development of Model Forest Management Plan for the Panjul Forest in Western Himalaya (Pakistan). L.W.F, L.M.U, Munich, Germany.
4. Khattak, A. K. (1994): Guidelines for Stand Delineation and Planning. GTZ-Siran Forest Development Project, Abbottabad.

(Specialization FM-III) Sustainable Forest Yield

Objective:

To equip the students with theoretical and practical knowledge and skills of calculation of forest yield under different edaphic, social and ecological conditions.

Course Outline:

1. Determination of forest yields by using different methods and formulas as (area, volumes increment, growth models) in different forest types.
2. Measurement of actual yield availability in forests under different silvicultural systems and under different social, ecological and edaphic conditions.
3. Comparison of yields by methods/formulas with actual availability of yield of different tree species and developing rational methods for yield calculations.
4. Developing methods of yield calculations of forest for meeting the objectives of:
 - a. Social uses
 - b. Biodiversity and wildlife conservation
 - c. Environmental considerations
 - d. Watershed values
 - e. Eco-tourism.

Practical

1. Field: The students will make inventory of forests and determine yield through methods/ formulas. Actual yield available will be measured in forests.
2. Lab: The yield of both the methods will be compared and rational methods designed for yield determination.
3. Field/ Lab: the students will determine yield of forests under different considerations such as social use, biodiversity, watershed values etc.

Recommended Books:

1. Clutter, J.L. J.C. Fortson et al. (1982). Timber Management: A Quantitative Approach. John Wiley and Sons. Inc. NY. USA.
2. Davis, K.P. and R.N. Johnson (1987). Forest Management. McGraw Hill Book Co., New York.
3. Lenschner, W.A. (1984): Introduction to Forest Resource Management, John Willey and Sons Inc. NY, USA.
4. Osmoston, F.E. (1968): The Management of Forest, George Allen and Unwin Ltd. London.

2. WATERSHED MANAGEMENT

(Specialization WM-I) Soil Conservation Techniques

Objective:

To give the student proper concept of the subject for practical application in modern perspective

Theory

1. Surface Erosion Control, Sheet & Rill erosion, contour ditches and their design criteria, types and design of terraces, vegetative measures
2. Gully Erosion Control, Low head & high head gully control with wood, stone /masonry work, design, kinds and construction of checkdams, vegetative measures.
3. Channel Erosion Control, Stream bank stabilization, rip-raping, retaining walls, gabions, revetments, Vegetative control
4. Landslide Erosion control, Identification and delineation of factors responsible for landslide hazards, Engineering and vegetative control measures
5. Water Conservation, Water harvesting methods, water spreading methods

Practical

1. Design of Terraces
2. Water Pond Design
3. Design of rip-raping for channel
4. Design of Retaining walls

Recommended Books

1. *Modelling Soil Erosion, Sediment Transport and Closely Related Hydrological Processes* entry by Mingyuan Du, Peiming Du, Taichi Maki and Shigeto Kawashima,
2. *Predicting soil erosion by water, a guide to conservation planning in the Revised Universal Soil Loss Equation*, U.S. USDA Agricultural Research Service, Agricultural handbook no. 703 (1997)
3. *A Designer's Manual*, Tagari Press, (1988). Increases in porosity enhance infiltration and thus reduce adverse effects of surface runoff by Bill Mollison,
4. FAO Conservation guides No.1,2,3,4 for Watershed Mgt. & Conservation
5. *Soil Conservation: Problems And Prospects* by R P C Morgan

(Specialization WM-II) Forest Meteorology

Objective:

To give the student proper concept of the subject for practical application in modern perspective.

Theory

1. Atmosphere, Climate & Weather, Definitions, layers and composition of layers
2. Heat Balance, Temperature & Clouds, Energy Budget, time lag, Measurement of radiations, definition & identification of clouds as weather indicators, Energy /temperature transfer characteristics, Inversions, Adiabatic lapse rate, mts. of temperature
3. Atmospheric Moisture, Vapour pressure, relative & absolute, humidity, Thermal/seasonal changes and mts.
4. Wind, Atmospheric Stability & Pressure patterns, Windspeed / direction, frontal & convective winds, Stable –unstable conditions, subsidence, convergence, high-low pressure system, mts of wind
5. Meteorological Observatory, Site selection, Layout, Establishment and orientation to various instrument and data collection

Practical

1. Storm frequency analysis
2. Energy Budget exercise
3. Lapse rate of temperature
4. Meteorological observatory

Recommended Books

1. Agricultural and Forest Meteorology by Diodato N., Bellocchi G., 2007.
2. Air Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather by Mark Monmonier
3. Meteorology by Miller Albert
4. Weather Life by Lowry, William.P.(1972)
5. Inventions of the Clouds. How an amateur meteorologist forged the language of skies by Richard Hamblyn (2008)

(Specialization WM-III) Forest & Range Hydrology

Objective:

To give the student proper concept of the subject for practical application in modern perspective

Theory

1. Introduction to Forest & Range Hydrology, Definition, Hydrologic cycle ,historical development of Hydrology
2. Surface water, stream flows & Hydrograph, Run-off measurements, velocity area method, rating curve, stage recording, Weir & flumes, Salt dilution method
3. Evapo-transpiration, Definitions & terminology, measurement of ET, Thornwaites equation, Penman's equation, reservoir pan evaporation
4. Infiltration & Sedimentation, Acquifers, measurement of infiltration, Hortons equation, measurement of surface, suspended and bed sediment, laboratory analysis of sediment.
5. Water Quality, Definition, need and standards of water quality, causes of deterioration, estimation of various parameters, Acid rain

Practical

1. Field visit of 2-3 hydrological stations with data collection for 2 days each.

Recommended Books

1. Discharge Measurements at Gaging Stations by Buchanan, T.J. and Somers, W.P., 1969
2. Water in Environmental Planning by Dunne, T., and Leopold, L.B., 1978,
3. Forest Hydrology by Lee Richards (1980)
4. Hydrology for Engineers by Linsley, R.K., M.A.Kohler and J.L.H. Paulhus (1958)
5. An outline of Forest Hydrology, Hewlett,J.O and W.L Nutter (1969)

3. RANGE MANAGEMENT

Specialization (RM-I) Range Vegetation Analysis

(Theory and Practical)

Objective:

To impart the students theoretical as well as practical knowledge of range vegetation analysis.

Course Outline

1. Range vegetation sampling. Various techniques used for range sampling.

2. Grazing/carrying capacity determination by using clipping and double sampling techniques.
3. Estimation of cover by using line intercept and step-toe/point quadrates.
4. Estimation of frequency and density by using plot (quadrates) and plotless techniques. Relationship of frequency and density to plant cover.
5. Estimation of range utilization by using height-weight, stem count, number of grazed and un-grazed plots and paired cages methods.
6. Estimation of range condition by using climax approach criteria (covers and forage production methods). Relationship between range condition and livestock production.
7. Estimation of range trend by using historical record method and United States Forest Service (USFS) four-factor method.
8. Range vegetation analysis through remote sensing.
9. Digestibility of range forage: effect of season upon forage digestibility, effect of species of animals on digestibility.
10. Grazing patterns and practices in Pakistan.

Recommended Books

1. Bonham, C.D. 1989. Measurements of terrestrial vegetation. John Wiley and sons.Inc. New York.
2. Stoddart, Smith and Box.1975. Range Management Mc Graw Hill Book, New York.
3. Range Management: Principles and Practices. Fifth Edition by Jerry L. Holechek, Rex D. Pieper and Carlton H. Herbel.
4. Masood A.A. Quaraishi. 1993.Range Management in Pakistan. University of Agriculture, Faisalabad.
5. Mohammad, N.1989. *Rangeland Management in Pakistan*. P: 198. International centre for Integrated Mountain Development, Kathmandu, Nepal.
6. Heady,H.F.1975.Rangeland Management Mc Graw Hill Book, New York.

Specialization (RM-II) Livestock Nutrition and Grazing Management

Objective:

Students will gain an understanding of the importance of range livestock nutrition and grazing management systems in major ecological zones of Pakistan.

Course Outline:

Range Livestock Nutrition

1. Physical features, palatability and nutrition of range forage species.
2. Methods for determining the nutritional value of grazing animal diets.
3. Diet and nutritional quality of livestock on different ranges.
4. Forage intake of grazing animals.
5. Comparative nutritive value of plant parts.
6. Seasonal effects on forage nutritional quality.
7. Grazing intensity effects on forage nutritional quality
8. Supplementing Range Livestock.
9. Poisonous and undesirable plants on rangelands and their control.

Grazing Management

1. Introduction to grazing management systems
2. Grazing resource inventory
3. Grazing plan development
4. Pasture management
5. Grazing systems and their monitoring

Practical

Plant analysis techniques. Visit to lab. and demonstration of plant chemical analysis. Visit to various pastures and range areas, demonstration of range vegetation and measurement of grazing pressure.

Recommended Books

1. Stoddart, Smith and Box.1975. Range Management Mc Graw Hill Book, New York.
2. Range Management: Principles and Practices. Fifth Edition by Jerry L. Holechek, Rex D. Pieper and Carlton H. Herbel.
3. Masood A.A. Quaraishi. 1993.Range Management in Pakistan. University of Agriculture, Faisalabad.
4. Mohammad, N.1989. *Rangeland Management in Pakistan*. P: 198. International centre for Integrated Mountain Development, Kathmandu, Nepal.

Specialization (RM-III) Drought Management in Rangelands

Objective:

To equip the students with different aspects of desertification, its control and drought problems in arid and semi-arid regions.

Course Outline:

1. Desertification-definition and its extent, severity and frequency. Causes and effects of land degradation in different regions.
2. Desertification in Pakistan
3. Sand-dune stabilization in Pakistan
4. Measures for combating desertification.
5. Water harvesting techniques
6. Drought control strategies and options
7. Droughts in Pakistan , frequencies and probabilities
8. Drought resistant fodder varieties
9. Early warning systems and drought management issues in relation to rangelands
10. Drought management plans

Recommended Books

1. Anonymous.1990. The Pakistan National Conservation Strategy. Ministry of Environment, Local Government and Rural Development, Islamabad.
2. Anonymous.2001. National Plan of action to combating desertification. Ministry of Environment, Local Government and Rural Development, Islamabad.
3. Stoddart, Smith and Box.1975. Range Management Mc Graw Hill Book, New York.
4. Range Management: Principles and Practices. Fifth Edition by Jerry L. Holechek, Rex D. Pieper and Carlton H. Herbel.
5. Masood A.A. Quaraishi. 1993. Range Management in Pakistan. University of Agriculture, Faisalabad.
6. Mohammad, N.1989. *Rangeland Management in Pakistan*. P: 198. International centre for Integrated Mountain Development, Kathmandu, Nepal.

4. GIS and RS Technology**(Specialization GRS-I) Geo Informatics****Objective:**

To enhance the knowledge and skill of students in using GIS and RS as a modern tool for the management of forest resources

1. Introduction to GIS
2. Map projections
3. Spatial Data
4. Spatial Data Models
5. Spatial Data Analysis
6. Global Positioning System
7. Map designing

Practical:

Introduction to GIS Software and hands on exercises on one of the current software.

Recommended Books

1. P.A. Longley, M.F. Goodchild, D.G. Maguire and D.W.Rhind. 2005. GIS and Science. 2nd edition. Wiley and Sons.
2. G.N. Peterson. 2009. GIS Cartography: A guide to effective map design, CRC Press.

(Specialization GRS-II) Land use Planning

1. Land use classification systems
2. Land use mapping
3. Land use Planning process
4. Role of GIS and RS in Land use Planning
5. Issues and constraints in Land use Planning
6. Strategies for sustainable Land use Planning

Practical

Project on the use of GIS and RS for Land use planning

Recommended Books:

1. Moudon, A.M. and M. Hubner. (Eds.) 2000. Monitoring Land supply with GIS: Theory, Practice and Parcel-based approaches. John Wiley and Sons. New York.
2. Von Meyer. N. 2004. GIS and Land Records: The Parcel Data Model Esri Press.

(Specialization GRS-III) Forest Assessment and Monitoring

1. Remote Sensing of vegetation
2. Image characteristics
3. Digital image analysis for forest resources assessment
4. Monitoring of forest resources

Practical

Introduction to RS software and hands-on exercises on one of the current software.

Recommended Books

1. Michael A. Wulder and Steven. E. Franklin (Eds.) 2003. Remote sensing of Forest Environments: Concepts and case studies. Springer.

2. Sabins, F.F. 2007. Remote sensing: Principles and Interpretation. 3rd Edition. Waveland Pr. Inc.

5. PARTICIPATORY FOREST MANAGEMENT

(Specialization PFM I) Community Based Forestry

Objective:

It will help students to understand socio-economic, cultural and ecological relationship between forests and people. It will acquaint students with the role of people in forest management through analysis of need dependence and traditional interactions between forests and society.

Course Outline

Theory

Forests and its importance, forest societies, interactions between forests and people, importance of forests in traditional farming systems, livestock economy and forests, social and cultural factors of forest management, man in ecosystem in relation to ecophilosophy.

Forestry and Afforestation programs and forest, wildlife and human conflicts. People's movement in forest conservation, Gender dimension of forest management. Tribals and forests. Forests and economic security of tribals. Pastoralists and their dependence on forests. Issues of people, forest and power.

Management of Commons and Common Property Resources (CPRs) and open access resources. Forest management and sustainable livelihood strategies. Forests and food security. Eco-tourism and local development. Land use change and forestry.

Forest rights, customary rights of people, community participation. Joint Forest Management. Global environmental change and land use – case study, poverty alleviation, livelihoods and forests; tourism and forest management; role of NGOs and other community based organization (CBOs) in forest management.

Suggested Readings

1. ADB. (2006). Strengthening Participation for Development Results: A Staff Guide to Consultation and Participation. Asian Development Bank.
2. Adhikari, B., Falco, S.D., and Lovett, J.C. (2004). Household characteristics and forest dependence: evidence from common

- property forest management in Nepal. *Ecological Economics* 48: 245-257.
3. Agarwal, B. (2001). Participatory exclusion, community forestry and gender: an analysis for South Asia and a conceptual framework [Electronic version]. *World Development* 29:1623-1648.
 4. Annamalai R. 1999. Participatory Learning Action and Microplanning for JFM. Dean SFRC, Coimbatore.
 5. FAO. 1978. Forestry for Local Community Development. FAO Publication.
 6. Hobley, M. (1996). The New Institution. In *Participatory Forestry: The Process of Change in India and Nepal. Rural Development Forestry Study Guide 3*. Hobley, M. Ed. Rural Development Forestry Network. Overseas Development Institute, London, UK:ODI
 7. Hobley, M. *Putting 'social' into forestry?* Forest Policy and Environment Programme: Grey Literature: ODI. November (2005).
 8. Klandermans, B. (1984). Mobilisation and participation: social psychological expansions lessons from Kwara State of Nigeria. *Community Development Journal*. 17:121-133.
 9. Korten, F.F. (1983). Community Participation: A Management Perspective on Obstacles and Options. In *Bureaucracy and the Poor: Closing the Gap*. Korten, (pp.183-200). David C. and Alfonso, Felipe B. Eds. West Hartford, Connecticut: Kumarian Press.
 10. Mamoona, W.M. (2010). Community Participation in Participatory Forest Management Programs in Azad Jammu Kashmir And Hazara's Districts of Pakistan. Unpublished doctoral dissertation, University Putra Malaysia.
 11. PFI. (1976). History of Forest Management. *Pakistan Journal of Forestry* 26:105-112.
 12. PFI. (1999). *State of Forestry in Pakistan (1999-2000)*. Pakistan Forest Institute (PFI). Peshawar. Ministry of Environment, Local Government & Rural Development, Peshawar: Government of Pakistan
 13. Uphoff, N.T. (1986). *Local Institutional Development: An Analytical Sourcebook with Cases*. Rural Development Committee, Kumarian Press: Cornell University.

(Specialization PFM II) Participatory Forest Management and Planning

Objective:

It will help students to understand planning process in Participatory forest management. It will acquaint students with the role of people in forest

management through analysis of need dependence and traditional interactions between forests and society.

Course Outline

Theory

1. Participatory forest management planning.
2. Evaluation of Participatory forest management.
3. Socio-economic considerations and policies.
4. Participatory approach for forest management and its impact.
5. Role of public organization, line departments and NGO's.
6. Review of major Participatory forest management projects of Pakistan.

Practical

Visits to various Participatory forest management projects: monitoring their characteristics: evaluation of their performance: observing local people's attitude: noting politico-economics considerations: evaluating social and public institutions.

Recommended Readings

1. Pallant, J. (2005). *SPSS Survival Manual: A step by step guide to data analysis using spss2nd* Edition. Glasgow: Bell and Bain Ltd.
2. Pandey, N. (2005). *Monitoring the Impact of Joint Forest Management on Rural Livelihoods*. A report of the study conducted during the summer internship at Winrock International-India. New Delhi. PGP-I. Aravali Institute of Management Jodhpur 342 006, Rajasthan.
3. Paul, S. (1987). *Managing Development Programmes: The Lesson of Success*. Boulders, Colorado: West View Press.
4. Mamoona, W.M. (2010). *Community Participation in Participatory Forest Management Programs in Azad Jammu Kashmir And Hazara's Districts of Pakistan*. Unpublished doctoral dissertation, University Putra Malaysia.
5. Roy, S. B. 1995. *Experiences From Participatory Forest Management*, Inter-india Publication

(Specialization PFM III) Participatory Forestry Assessments

Objective:

It will help students to understand Peoples' participation and management partnerships, socio-economic, and ecological impact assessments of PFM. It will acquaint students with the tools of participatory assessment.

Course Outline

Theory

Peoples' participation and management partnerships. Forest policies and social context. The basis of participatory assessment. Participatory baselines. Participatory evaluation. Information analysis and communication of results.

The tools of participatory assessment. Guidelines for assessment of participatory forest management programs. Claims and aspirations for PFM by different actors and the main opportunities and constraints to their achievement. The most important factors in facilitating or inhibiting PFM to enhance livelihoods of poor.

Socioeconomic and ecological Impact assessment reviews of different PFM programs and their implementation strategies in various countries.

Recommended Readings

1. ADB. (1996). Framework for Mainstreaming Participatory Development Processes into Bank Operations. Manila: Asian Development Bank.
2. Ali, T., Ahmad, M., Shahbaz, B., and Suleri, A. (2007). Analysis: Impact of participatory forest management on financial assets of rural communities in Northwest Pakistan [Electronic version]. *Ecological Economics*. 63: 588-593.
3. Ali, T., Shahbaz, B. and Suleri, A. (2006). Analysis of myths and realities of deforestation in Northwest Pakistan: implications for forestry extension [Electronic version]. *International Journal of Agriculture and Biology*. 81: 107–110
4. Ghimire, K. (1998) *Forest or Farm? The Politics of Poverty and Land Hunger in Nepal*, New Delhi, Manohar Publication
5. Hobley, M. (1996) *Participatory Forestry: The Process of Change in India and Nepal*, London, Overseas Development Institute, Rural Development Forestry Study Guide No 3
6. Jeffery, R. and Sundar, N. (eds) (1999) *A New Moral Economy for India's Forests?*
7. *Discourses of Community and Participation*, New Delhi, Sage.
8. Kanel, K. (2004) 'Twenty-five years of community forestry: Contribution to Millennium Development Goals', in *Proceedings of the Fourth National Workshop on Community Forestry*, 4–6 August, Kathmandu, Nepal
9. Kristen Evans. 2006. *Guide to participatory tools for forest communities*. Center for International Forestry Research.
10. Malla, Y. B. (2000) 'Impact of community forestry policy on rural

- livelihoods and food security in Nepal', *Unasylva: International Journal of Forestry and Forest Industries*, vol 51, no 202, pp37–45
11. Malla Y. B., Hari, N. and Branney, P. (2003) 'Why aren't poor people benefiting more from community forestry?', ODI Rural Development Forestry Newsletter/Journal of Forests and Livelihoods, London, ODI
 12. Mamoona, W.M. (2010). Community Participation in Participatory Forest Management Programs in Azad Jammu Kashmir And Hazara's Districts of Pakistan. Unpublished doctoral dissertation, University Putra Malaysia.
 13. Pallant, J. (2005). SPSS Survival Manual: A step by step guide to data analysis using spss2nd Edition. Glasgow: Bell and Bain Ltd.
 14. Pandey, N. (2005). Monitoring the Impact of Joint Forest Management on Rural Livelihoods. A report of the study conducted during the summer internship at Winrock International-India. New Delhi. PGP-I. Aravali Institute of Management Jodhpur 342 006, Rajasthan.
 15. Paul, S. (1987). Managing Development Programmes: The Lesson of Success. Boulders, Colorado: West View Press.
 16. PFI. (1976). History of Forest Management. *Pakistan Journal of Forestry* 26:105-112.
 17. PFI. (1999). State of Forestry in Pakistan (1999-2000). Pakistan Forest Institute (PFI). Peshawar. Ministry of Environment, Local Government & Rural Development, Peshawar: Government of Pakistan
 18. Pokharel, R.K. and Larsen, H.O. (2007). Local vs official criteria and indicators for evaluating community forest management. *Institute of Chartered Foresters*. doi:10.1093/forestry/cpm005. *Forestry* 80(2).
 19. Rossi, F.J. (2007). Socio-Economic Impacts of Community Forest Management In Rural India. Unpublished doctoral dissertation, University Of Florida.
 20. Rossie, P.H. and Freeman, H. E. (1993). Evaluation A Systematic Approach 5th ed. Newbury Park, London: SAGE Publications.
 21. Roy, S. B. 1995. Experiences From Participatory Forest Management, Inter-india Publication

SERICULTURE

Objective:

To equip the students with sericulture cottage industry for rural development, multiple uses of forests, and sustainable forest resources management.

Course Outline

(Specialization SC-I) Silkworm Rearing

1. History of Sericulture
2. By-products of sericulture
3. The mulberry silkworm, *Bombyx mori*
4. Basic requirements for silkworm rearing
5. Incubation of silkworm eggs
6. Silkworm rearing techniques/methods and ecological requirements
7. Silkworm breeding and genetics of silkworm
8. Mechanization in sericulture
9. Mounting, types of mountages, and cocoon quality parameters
10. Diseases of silkworm and their management
11. Economics of sericulture, concepts of benefit-cost ratio, marketing
12. Extension education in sericulture

(Specialization SC-II) Silk Seed and Cocoon Technology

1. Preparatory requirements of silk seed crop
2. Rearing and feeding methods of silk seed crop
3. Production of reproductive seeds
4. Production of industrial seeds
5. Preservation of silk seed
6. Oviposition & fertility parameters, and egg preservation
7. Egg treatment and hatchability
8. Hybrid vigour and heritability
9. Investigation of trans-oval diseases
10. Synthesis of silk proteins
11. Cocoon production technologies/mechanization
12. Post cocoon activities
13. Cocoon storage and environmental factors
14. Pre-reeling processes and silk reeling
15. Characterization of raw silk

(Specialization SC-III) Moriculture

1. Mulberry Plant and its ecological requirements
2. Nursery raising of mulberry
3. Methods of mulberry propagation and silvicultural treatments
4. Establishment of mulberry plantation and its management
5. Harvesting and storage of mulberry leaves
6. Diseases and insect pests of mulberry and their management

Practical

1. Practice of disinfection methods
2. Incubation of silkworm eggs
3. Practice of silkworm operations
4. Silk seed production
5. Cocoon harvesting and characterization
6. Reeling and raw silk testing
7. Silk seed preservation
8. Practice of mulberry propagation techniques
9. Nursery raising

Recommended Books

1. Anon, 1977. Handbook of Sericulture. Seoul: Kyungpook National University.
2. Ganga, G. 2003. Comprehensive Sericulture. Volume I: Moriculture. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
3. Ganga, G. 2003. Comprehensive Sericulture. Volume II: Silkworm Rearing and Silk Reeling. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
4. Hamamura, Y. (Ed.) 2001. Silkworm Rearing on Artificial Diet. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
5. Sathe, T.V. and Thite, S.H. 2004. Shoot Feeding & Sericultural Trends. New Delhi: Daya Publishing House.
6. Singh, T. and Saratchandra, B. 2004. Principles and Techniques of Silkworm Seed Production. New Delhi: Discovery Publishing House.
7. Tazima, Y. (Ed) 1978. The Silkworm: an important laboratory tool. Tokyo: Kodansha.

WOOD SCIENCES AND TECHNOLOGY

(Specialization WST-I) Wood Harvesting Techniques

Objective:

To educate the students with the knowledge and skills of cutting trees, transportation and stacking of timber.

Course Outline

1. Tree felling and Conversion. Merits and demerits of tree felling techniques used in Pakistan: Felling with saw, axe, saw and importance of direction of felling; choice of a felling method; timber losses in felling and their causes; measures for improving wood productivity during felling; safety measures against accidents during

fellings; felling vs soil conservation; forest protection; silvicultural aspects and watershed values; logging and other timber conversion operations; classification and description of various forms of converted timber, safety measures in logging and cross cutting operations.

2. Timber Extraction and Transportation. Importance, economical aspects and scope of following timber extraction techniques in Pakistan; extraction by rolling. Dragging, animals, animal carts, slides, forest railways, overhead transport, water transport, skidding and winching; Timber sizes; minor and major means of timber transportation.
3. Grading and storage of timber. Basis and importance of grading of sawn and round timber; grading specifications for round and sawn timber used at the felling stations and forest depots; grading practices in Pakistan at different places; stacking of round and sawn timber at felling sites and forest depots. Latest sale price of various grades of timber and fuelwood in the depots.
4. Wood marketing: Difference between sale and disposal, merits, demerits and economic importance of different sale and disposal; systems in Pakistan, application and scope of different sale methods. Forestry in the market place: Forest Products; the economics of forestry. Grading and storage of timber in the market.
5. Work Organization: Types and availability of forest labour; different wage system; importance and choice of wage systems.

Practical

Field: To study tree felling, cross cuttings, sawing into scants, transportation and marketing of timber.

Recommended Books

1. Brown, N.C. (1950). Logging, John Wiley & Sons. New York.
2. Zarembo, W. (1976). Logging Reference Manual Vol.13. Department of Forestry Private Bag-3. Republic of South Africa (Pretoria).
3. Sinclair, Steven,A. 1992. Forest product marketing. McGraw Hills. Inc. New York

(Specialization WST-II) Wood structure and Identification

1. Introduction: wood formation process, cambial zone and cambium, Kind and arrangement of cambial initials in the cambium, shape and size of cambial initial in softwood and hardwood ,longitudinal and transverse enlargement of young xylery cells following their formation ,increase in the girth of cambium. Complete description of different types of cells forming the wood, cell wall thickness and process of lignifications, pits,

their structure and types, chemical composition of cell wall, different cell wall layers and their ultra-structure identification, anatomical, physical and chemical properties of reaction wood, causes of formation of reaction wood. Reaction wood as a defect.

2. Special structural features of softwood and hardwoods.
3. Wood quality variations within a tree species. Quality of wood in relation to position in the stem. Variation in structure, density and strength at different heights and branch, trunk and root wood. Quality of wood in relation to growth increment.
4. *Laboratory methods*. Microscopy, optical and electron microscope, use and care of microscopes, fundamentals of micrometry, photographic cameras, films papers and photomicrography. Preparation of wood for microscopic examination.

Practical

Laboratory work in the study of wood structure, micro techniques such as cutting of sections of timbers, staining and making of permanent slides, maceration of wood, microscopy of micrometry. Making photomicrographs, practical work in identification of Pakistani timbers.

Text Books Prescribed

1. Allen, R.M Photomicrography. D. Van Nostu and Company, Inc. New York, 1946.
2. Brown, H.P., *et al* Text book of wood technology (two vols.) McGraw Hill Book, New York, 1940.
3. Cote, W.A. Cellular ultra structure of woody plants. Syracuse University Press, 1965.
4. Johansen, D.A. Plant micro techniques. McGraw Hill Book Company, Inc., New York and London, 1940.
5. Pearson, R.S., and Commercial timbers of India (two vols) Calcutta
Brown, H.P Central Publications Brach, 1932.
6. Trotter, H. Common commercial timbers of India and their use. Dehra Dun, Vasant Press, India, 1944.
7. Wredde, J.H. The microscope J&A Churchill Ltd., London, 1947.
8. Wykoff, R.W.G Electron microscopy. Interscience Publishers Inc., New York, 1949.

Recommended Books

1. Ahmad, S.S. and M. Ayaz Identification of some of the common commercial timbers of West Pakistan. Forest Products Bulletin No.1, Pakistan Forest Institute, Peshawar, 1970.

(Specialization WST-III) Wood Testing and Processing

1. Wood testing: Recent developments in the testing of wood for physical and mechanical properties of wood such as wood moisture relationship, sorption, desorption and the phenomenon of hysteresis. Flow of liquids and gases into wood. Electrical, thermal and acoustical properties, their significance and measurement. Electrical and thermal conductivity of wood. Thermal expansion and calorific value of wood. Acoustical behaviour of wood. Factors affecting the thermal, electrical and acoustical properties. Non destructive methods of testing wood. Grading of sawn timber. Factors affecting the grade of wood, visual grading. Principles of machine grading. Derivation of basic grade and working stresses. Application of working stresses for the design of simple beams and columns.
2. Wood processing- Preparation of wood for drying and treatment. Energy consumptions in wood drying. Special drying methods like vapor drying, dehumidifiers, forced air drying, solvent drawing, high temperature drying, chemical seasoning. R.F. drying of wood and solar drying. Recent developments in the preservation of wood. Methods of testing the effectiveness of various preservatives including laboratory and field tests. Preservation of wood for special use such as marine timber for cooling towers, railway sleepers, cross arms, furniture and joinery. Fire retardant treatments. Theories of fire retardancy.

Practical

1. Laboratory measurement of various physical and mechanical properties by different methods
2. Stacking of wood for air and kiln seasoning.
3. Control of kiln seasoning process.
4. Treatability of different woods with preservatives

Text Books prescribed

1. Anonymous Lumber seasoning. Forest series U.S. Department of Agriculture, 1962.
2. Armstrong, F. H. The strength properties of Timber. F.P.R. Bulletin No. 45 H.M.S.O. (1960).
3. Kollmann, F.P. & W.A Cote Principles of wood science and technology, Vol. 1. Springer Verlag. Berlin. 1968.
4. Siau, J.F. Flow in wood. Syracuse Wood Science Series 1. Syracuse University Press, New York (1971).

(Specialization WST-IV) Wood Based Products

1. Introduction, description, classification, properties and uses of panel products.
2. Plywood, veneer plywood, core plywood and other plywoods.
3. Particleboard, Particleboard flat pressed, particleboard extruded.
4. Fiber board, Insulating board, Medium hardboard regular S1-S, Medium hardboard regular S-2-S and hardboard.
5. Panels mineral bonded, wood particles based, straw panel board, and other panels.
6. Laminated wood, its manufacture and uses.
7. Characteristics of raw materials used in the manufacture of different wood based panels. Raw material supplies in Pakistan.
8. Advantages of panel products over solid wood. Role of panel products and laminated wood in forest conservation. Scope of panel products and laminated wood Industry in Pakistan.
9. Quality standards for predicting specific end use of different panel products.
10. Adhesives, Nature and properties of adhesives used in modern production of plywood, particleboard and laminated wood. Adhesive components, fillers and extenders. Catalysis, fortifiers, Polymerization. Factors governing choice of adhesives, durability of adhesives ease of use in manufacture, cost of adhesive. Methods of testing adhesives.

Practical

Strength testing of panel products-Modulus of rupture ,Modulus of elasticity, nail with drawal resistance, screw holding capacity ,water and moisture absorption. Bond quality testing of laminated products.

Text Books Prescribed

1. Kollman,F.F.P. *et al.* Principles of wood science and technology. Vol.II. Springer Verlag. Berlin, 1975.
2. Chugg,W.A. Glulam. Earnest Benn Ltd. London, 1964.
3. Perry,T.D. Modern plywood. Pitman Publishing Corporation, New York, 1948.
4. Houwink,R., & Salomon,G. Adhesion and adhesives. Vol.I & II. Elsevier Publishing Company London, 1965.

8. WILDLIFE MANAGEMENT

(Specialization WLM-I) Wildlife Biology and Ecology

1. Importance of invertebrates to conservation: role of invertebrates in food chains and diversity, insects and molluscs of importance in wildlife biology.
2. Vertebrates: review of biology of major groups with emphasis on important species in wildlife management.
3. Ecological principles: Ecosystem, communities and population. Productivity concept of hunting factors, competition & tolerance, dispersion.
4. Habitat Ecology: Broad classification of wildlife habitats in Pakistan. The role and practice of habitat evaluation in conservation.
5. Vertebrate Ecology: Animal habitat interactions. The niche concept. Feeding ecology: Feeding of herbivores, omnivores and carnivores, predation, food, nutrition and animal health, carrying capacity, Biomass.
6. Population Ecology: Biological and geographical populations. Abundance and density, mortality and natality, population structure, age and sex classes. Age and sex determination.
7. Wildlife behavior, relevance of ecology to management.

Book Prescribed

1. Frankel, O.H. and M.E. Soule (1981). Conservation and Evolution, Cambridge University press.
2. Robert, T.J. (1977). The mammals of Pakistan. Oxford University press.
3. Robert, T.J. (1991). The birds of Pakistan (vol –I and II) Oxford University press.
4. Soule, M.E. and B.A. Wilcox (1980). Conservation Biology, Sinauer Associates Inc. Sunderland, Massachusetts.
5. Usher M.B. (1973). Biological Management and Conservation Chapman and Hall, London.
6. Sinclair, Anthony R.E. Feycell, John M: Caughly, Graeme, 2009 Wildlife Ecology, Conservation and Management, Wiley Blackwell
7. Robinson, W.L and Eric G. Bolen. 1984. Wildlife Ecology and Management Mc Millan Publishing Co. New York.

(Specialization WLM-II) Wildlife Management and Research

Part – I Wildlife Management

1. Habitat Management: Design and implementation of monitoring programmes. The development and management of natural and

- artificial water supplies and salt licks. Fire as a supply tool. Management of vegetation as cover and as food supply. Grazing control.
2. Management of Animal Communities: Design and implementation of protection and monitoring. Management of small populations. Animal damage problems: Man eating, stock lifting and crop damage. Special management of rare and endangered animals including aquatic species.
 3. Human Dimensions: Ecology and economy of rural communities. Land use pressures and incompatibilities. Control of human activities in protected areas: Domestic stock, encroachment, removal of forest produce. Alternative development strategies. Management of multiple use and peripheral zones.
 4. Captive management and utilization: Captive breeding programmes. Wildlife ranching wildlife farming. Possible utilization project.
 5. Wildlife programmes planning.
 6. Management planning and implementation: Protected area values, goals and objectives. Management strategies. Ecological and legal boundaries. Concept of zonations, zone objectives and management. Management plan preparation.

Part - II Wildlife Research

1. Planning wildlife management investigation and project, programme development, problem statement, the planning process, the investigational plan.
2. Wildlife management literature, serial and monographic literature book reviewing media, abstracting and indexing services, subject bibliographic, organization and preparation of the research paper.
3. Making observation and records, field notes, photographic record taking.
4. Writing the scientific report.
5. Human surveys in wildlife management.
6. Wildlife investigational techniques.

Books Prescribed

1. Frankel, O.H. and M.E. Soule (1981). Conservation and Evolution. Cambridge University press.
2. Robert, T.J. (1977). The mammals of Pakistan (Vol-I & II) Oxford University press.
3. Robert, T.J. ((1991). The birds of Pakistan (Vol-I & II). Oxford University press.
4. Schemnitz, Sanford D. Wildlife Management Techniques Manual, The Wildlife Society, Washington, D.C.

5. Soule, M.E. and B.A. Wilcox (1980). Conservation Biology. Sinauer Associates Inc. Sunderland, Massachusetts.
6. Teague, Richard. D. A Manual of Wildlife Conservation, Colorado State University, Fort Collins, Colorado. The Wildlife Society Washington D.C.
7. Usher M.B. (1973). Biological Management and Conservation. Chapman and Hall, London.
8. Fulbright, Timothy E. 2007. Wildlife Sciences CRC Press UK.
9. Bailey, J.A. 1984. Principles of Wildlife Management, John Wiley & Sons Inc USA
10. Giles, R.H. Jr. 1987. Wildlife Management W.H. Freeman & Co. San Francisco.

(Specialization WLM-III) Wildlife Policy, Laws and Administration

I. Wildlife Policy and Laws

1. The legislative process and wildlife.
2. Historical background and evolution of current wildlife laws.
3. Provincial wildlife acts/ordinances and targets species.
4. International wildlife pacts, treaties and conventions.
5. Effectiveness of the current wildlife laws and scope for future improvement.

II. Wildlife Administration

1. Current wildlife administration practices in Pakistan.
2. Conservation of natural resources: Wildlife as a natural resource. Objectives of conservation. History of conservation in Pakistan and factors affecting conservation. National conservation strategy. Protected areas: International, national and world heritage sites. The role of zoological and botanical gardens. National and International agencies for conservation.
3. Tourism, interpretation and wildlife education: Importance of tourism, tourism development. Techniques of wildlife interpretation for protected areas and zoos, visitor centers, museum, nature trails, guides, wildlife education and its importance for rural people, students and decision makers. Development of materials. Role of NGOs and the media.

Book Prescribed

1. Frankel, O.H. and M.E. Soules (1981). Conservation and Evolution. Cambridge University press.
2. IUCN (1993). Biodiversity Conservation and laws. Environmental policy and law paper. No.29.PP 292.

3. Provincial wildlife acts and ordinances, (Provincial Wildlife Department).
4. Rao, A.L. (1984). The wildlife legislation of Pakistan M.Sc Thesis, University of Edinburgh, National council for conservation of wildlife, Islamabad.
5. Shafiq M.M. (2005).Compiled Wildlife Acts and Rules of Pakistan. PFI, Publication.
6. Roberts, T.J. (1977). The Mammals of Pakistan. Oxford University press.
7. Roberts, T.J. (1991). The Birds of Pakistan (Vol – I). Oxford University press.

9. AGROFORESTRY

(Specialization AF I) Agroforestry Systems

1. Introduction.
 - a. Definition of Social Forestry, Types of Social Forestry: Agro forestry. Farm Forestry, Participatory Forestry, Village/community Forestry, Extension Forestry. Amenity Forestry, Rehabilitation Forestry and Compensatory Forestry.
 - b. Other Types of Forestry: Energy Forestry and Industrial Forestry.
 - c. Importance, Scope and Need of Agro Forestry regarding development of Forest Resource and its impact on Forest Management and Farm Management.
 - d. Reviews of historical background of Agro forestry. Agroforestry in contrast with Traditional Agriculture, Range Management and Forestry.
2. Agriculture Farm Management: Scope and development of farm management. Economic conditions of the farmers in Pakistan. Farm possession, ownership, and lease, cash & crop lease, size of farm. Nature of farming and its characteristics. Types of farming present on various farms. Introduction to major fruit crops.
3. Definition of a system, farming system and agro forestry system; Importance, need, objectives and potential of Agroforestry systems. Agro forestry Systems classification by: i- Major components: Agrisilvicultural, silvopastoral, Agro silvopastoral and other systems. ii- Temporal and spatial character. iii- Function or application. iv- Spread and management.
4. Agro forestry Systems Current Agro forestry systems in

Pakistan in view of establishment, Cultural and Harvest Techniques.

- a. Rotation Systems (Hurri)
 - b. Permanent Tree and Field Crop Systems.
 - c. Tree-Pasture Systems: Broadleaved and conifer species with grass and other forage species with domestic animals.
 - d. "Minor" Forest Products systems.
5. Agro forestry Systems in Latin American, African and Asian Countries.
- a. Rotation Systems.
 - b. Intercropping
 - c. Permanent Tree and Field Crop
 - d. Tree and Aquatic
 - e. Tee and Forage
 - f. Misc. Forest Products such as Medicinal Plants.
 - g. Kitchen Gardens (Home Gardens).
6. Designing Agro forestry Systems.
- a. Land capability classifications and their application to design of agroforestry.
 - b. Diagnosis and Design (D&D) Method.
 - i. Objectives of method and design criteria.
 - ii. Use as iterative design and implementation process.
 - iii. Procedural steps: Description. Diagnosis. Technology Design. Implementation Planning. Relationship to Farming Systems Approach.
 - c. Farming Systems Research Methodology
 - i. The farm as a system combining animal, field tree and pastoral crops.
 - ii. Use as an analytical tool and for outreach program.
 - iii. Procedural steps: Characteristics and analysis of system. Planning and design for improvement. Generation/Evaluation of technologies information accumulation and analysis of improved farm system. Re-evaluation of technology and dissemination via extension.

7. Role of Agroforestry/Farm Forestry. Specialist.
 - a. Service to forestry department: Promote national and provincial departmental objectives.
 - b. Service to farmers/land owners: Serve farmers' objective, technical advisor, out reach capacity.
 - c. Conflict of interest: Farmer's objective vs. departmental objective.
 - d. Financial and economical analysis of a farm and agroforestry system.
 - e. Case studies in farm and agroforestry systems success and failure in Pakistan.

Recommended Books

1. Hafeez, M.C. (1986). Agroforestry and its strategies for Pakistan. MS. Thesis. Oxford Forestry Institute, Oxford. Copy available at PFI, Peshawar.
2. Hockstra, D.A. 1983 a. The Use of Economics in Agro forestry. Working Paper No.1 (Nairobi: International Council for Research in Agro forestry.
3. Hockstra, D.A. 1983 b. The Use of Economics in Agro forestry. Working Paper No.2 (Nairobi: International Council for Research in Agro forestry.
4. ICRAF, 1987. D&D User's Manual: An Introduction to Agro forestry Diagnosis and Design. ICRAF. Nairobi, Kenya.
5. ICRAF, 1983. Guide lines for Agro forestry Diagnosis and Design. Working PAPER No.6. International Council for Research in Agro forestry. ICRAF. Nairobi, Kenya.
6. ICRAF, 1983. Guide lines for Agro forestry Diagnosis and Design. Working PAPER No.7. International Council for Research in Agro forestry. ICRAF. Nairobi, Kenya.
7. ICRAF "Agro forestry today", (Quarterly), Nairobi. Kenya.
8. Lawrence R. Kellimore. 2010. Handbook on Agroforestry: Management Practices and Environmental Impact. Lawrence R. Kellimore (Editor)
9. M P Divya, K T Parthiban L . 2008. Social Forestry and Agroforestry. Satish Serial Publishing House.
10. Mamoona, W.M. (2010). Community Participation in Participatory Forest Management Programs in Azad Jammu Kashmir and Hazara's Districts of Pakistan. Unpublished doctoral dissertation, University Putra Malaysia.
11. N.A.S. 1983. Firewood Crops: Shrub and Tree Species for Energy Production. (Washington: National Academy Press.
12. Nair, P.K.R. et al. 1989. "Agro forestry System in the Tropics", Klower Academic Publishers. P.O. Box 17 3300 AA Dordrecht, The Netherlands.

13. Shibu Jose and Andrew M. Gordan. 2008. *Towards Agroforestry Design: An Ecological Approach*
14. Vergara, N.T. & K.G. Mac Dicken. 1990. *Agroforestry: Classification and Management*. John Willey and Sons. New York. Pp. 382.

(Specialization AF II) Farm Forestry Management

Course Outline

1. Multiplicity of Agroforestry products and services- ecological and economic and cultural considerations- gender equality- preservation of indigenous knowledge. Socioeconomic benefits of agroforestry.
2. Adoption of AF- Determinants of adoption: feasibility, profitability, and acceptability. Adoption behavior influenced by risk, biophysical, and resource factors: land, labor, income, inputs, experience, social capital, training and membership in farmer cooperatives. Self-efficacy in farmer decision-making - policy aspects.
3. Sustainability of land use systems- soil conservation and sustainability-agroforestry for soil conservation- soil restoration- need and reclamation of degraded soils, flood prone areas. Mine spoils and ravines- selection of species and techniques - agroforestry for maintenance of soil fertility, ecological balance and conservation of biodiversity.
4. Management innovation in agroforestry systems of the tropics.
5. Agroforestry for maintenance of soil fertility, ecological balance and conservation of biodiversity. Management innovation in agroforestry systems of the tropics.

Practical

1. Agroforestry product inventory
2. Lab Exercise on familiarization of multipurpose tree databases.

Suggested Readings

1. Buck, Lassoie, Fernandes 1999. *Agroforestry in Sustainable Agri. Systems*, CRC Press.
2. Dwivedi AP. 1992. *Agroforestry: Principles and Practices*. Oxford & IBH.
3. Garrett, Rietveld, Fisher: 2000 *North American Agroforestry*, ASA, Madison, USA.
4. Gordon and Newman: 1997 *Agroforestry Systems in the Temperate Zone*, CAB Int'l.
5. McDicken and Vergara: 1990 *Agroforestry*. Wiley, New York
6. Mamoon, W.M. (2010). *Community Participation in Participatory*

Forest Management Programs in Azad Jammu Kashmir And Hazara's Districts of Pakistan. Unpublished doctoral dissertation, University Putra Malaysia.

7. Lawrence R. Kellimore. 2010. Handbook on Agroforestry: Management Practices and Environmental Impact. Lawrence R. Kellimore (Editor)
8. M P Divya, K T Parthiban L . 2008. Social Forestry and Agroforestry. Satish Serial Publishing House..
9. Mayer, P.M., Reynolds, S.K., McCutchen, M.D., Canfield, T.J., 2007. *Meta-analysis of nitrogen removal in riparian buffers*. Journal of Environmental Quality 36, 1172-1180.
10. Nair, P.K.R., Rao, M.R. and Buck L.E. (eds.) 2004. *New Vistas in Agroforestry. A Compendium for the 1st World Congress of Agroforestry*. Kluwer Academic Publishers, Dordrecht, The Netherlands
11. Nair PKR, Rai MR & Buck LE. 2004. *New Vistas in Agroforestry*. Kluwer.
12. Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer.
13. Ong CK & Huxley PK. 1996. *Tree Crop Interactions – A Physiologica Approach*. ICRAF.
14. Thampan PK. 1993. *Trees and Tree Farming*. Peekay Tree Crops Development Foundation.
15. Schultz, R.C., Isenhardt, T.M., Simpkins, W.W., Colletti, J.P. 2004. *Riparian forest buffers in Agroecosystems - lessons learned from the Bear Creek Watershed, central Iowa, USA*. Agroforestry Systems 61, 35-50.
16. Shibu Jose and Andrew M. Gordan. 2008. *Toward Agroforestry Design: An Ecological Approach*.
17. Young A. 1997. *Agroforestry for Soil Management*. CABI.

(Specialization AF III) MARKETING OF AGROFORESTRY PRODUCTS

Course Outline

1. Nature and scope of marketing. Approaches to marketing functions. Marketing System, Marketing System of Agroforestry Products, Marketing of tree products, The 'black box' of agroforestry markets, characteristics of small and local markets.
2. Marketing Structure Analysis: Study of market structure and conduct of wood and wood product markets, marketing channels, costs, margins and price spread for selected wood and wood products. Locations and features of specialized markets
3. Marketing Channels of Agroforestry Products, Marketing Margin Analysis for Agroforestry wood products.

4. Agroforestry Marketing problems, prospects and challenges, and gender issue.
5. Agroforestry Marketing Policy.
6. Wood Product Percentage from Agroforestry Trees, Marketing Margins of Different tree species' Products. Contribution of Agroforestry Products to Rural Livelihoods.
7. Marketing and Marketing strategies for non-wood forest products: Cooperative Societies. Exploring market expansion through value addition by improved post-harvest processing value addition methods, organic products, processing of bamboos and fruits.

PRACTICALS

Local surveys on agroforestry markets, product outflow, inflow regulatory mechanisms. Case studies on harvesting, postharvest management and marketing of agroforestry products.

Visit to marketing institutions and forest industries.

Recommended Books

1. Arnold, J.E. M. (1991). Community forestry ten years in review. Forest, trees and people. Community Forestry Note 7: 20-23.
2. Arnold, J. E. M. (1997). Retrospect and prospect. In farms, trees and farmers: Responses to agricultural intensification. J. E. M. Arnold and Peter A. Dewees (eds.). pp 271-287. Earthscan, London.
3. FAO. 2002. *Trees outside forests. Towards better awareness*. FAO Conservation Guide 35. Rome: FAO.
4. FAO 1993. Marketing of Wood Fuels in Peshawar City, Pakistan. Regional Wood Energy Development Programme in Asia. Bangkok.
5. FAO 1996. Report on the Regional Course on Trade in Wood Fuel Related Products. Regional Wood Energy Development Programme in Asia. Bangkok.
6. Mamoona, W.M. (2010). Community Participation in Participatory Forest Management Programs in Azad Jammu Kashmir And Hazara's Districts of Pakistan. Unpublished doctoral dissertation, University Putra Malaysia.
7. Mamoona, W.M. (2004). The Role of Gender in Community forestry / Agro-forestry in Pakistan Published in the Proceedings of the Workshop "Forests for Poverty Reduction: Can Community Forestry Make Money?" 1-2 September, 2003 Beijing China, FAO/APAFRI/CAF, RAP Publication 2004/04
8. Mamoona, W.M. (2000). "Gender Role in Agro-forestry" in District Attock, Punjab, Pakistan Journal of Forestry 87-96 Vol. 50(1-2) 2000.

9. Mamoona, W.M. (1999). "Feasibility Study Report on Agroforestry/Community Forestry of NWFP Barani Area Development Project Phase II (PPTA)", Asian Development Bank / Government of NWFP, 1999.
10. Mamoona, W.M. (1997). The Role of Women and Biomass Energy in Small to Very Small Rural Industries in Pakistan" RWEDP Report No. 35 , p 52-63 FAO UN Bangkok 1997
11. Mayer, Andre. 1974. Charcoal. (Rome: Food and Agriculture Organization of the United Nations)
12. PFI 1986. Proceedings of the National Training Workshop on Fuelwood Trade in Pakistan. Pakistan Forest Institute, Peshawar.
13. Qazi, I.A. 1989. Wood Based Energy System in Rural Industries and Village Application. Pakistan. Field Document 13. FAO/REWDP Bangkok.
14. Siddiqui, K.M. 1997. Woodfuel Energy in Pakistan. Pakistan Forest Institute, Peshawar.

10 FOREST ENGINEERING & LOGGING

Specialization (FEL-I) Forest Machinery

1. Engines: Petrol and Diesel engines and their working
2. Mechanics and hydraulics of forestry machines, clutches, and gear systems
3. Hydrostatic and hydro dynamic drives
4. Skidder in the terrain, trafficability, traction, friction, curve-radius, tilting.
5. Winches and cable cranes.
6. Power saws: engines, carburetor, clutch, chains
7. Repair and maintenance of chain saws
8. Forest machines and their maintenance, spare parts.
9. Machine cost calculation: Investment, repair and operational costs
10. Exercises & practical:
 - i. Machine cost calculation
 - ii. Optimal depreciation period of a machine
 - iii. Data and Record keeping of machines

Recommended Books:

1. Automotive machining and Engine repair. By Gery Lewis, 2000
2. Diesel Engine and Fuel System Repair by John F. Dogel, 1998
3. Modern Diesel Technology by D. Gruden, 2003
4. Chain Saw in Tropical FAO Teaching Series 1980

Specialization (FEL-II) Forest Logging

Tree Felling & Conversion

1. Tree felling methods, directional felling
2. Tools: manual tools: axes, saws, wedges, sapies, bill hocks, log turners
3. Mechanical chain saws: mechanical and hydraulic devices for directional felling; felling machines.
4. Improvement of utilization by advanced felling methods.
5. Time and cost studies in timber harvesting operations
6. Wage system for felling and conversion. Piece rate, bonus system
7. Accident during felling and conversion and their control.
8. Safety regulations.
9. Debranching: methods, tools and machines, time consumption and cost calculation. Utilization of branches.
10. Debarking: methods, tools and machines: time consumption and cost calculation. Utilization of bark, un-debarked wood.
11. Cross-cutting: Utilization of logs; economical cross-cutting of logs, transportation of tree lengths and log lengths.
12. Mechanized timber harvesting system

Timber Extraction & Transportation

1. Primary Transportation: Methods, tools, machines, time consumption and cost calculation.
 - i. Sliding by gravity
 - ii. Rolling
 - iii. Skidding by animal and tractors
 - iv. Yarding by winches and cable cranes
2. Accidents and safety regulations.
3. Wage systems.
4. Secondary transportation: by trucks, loading and unloading, travel speed, costs
5. Improved logging Trucks, winches and cost for loading and unloading.
6. Rail-roads, shipping, floating, and other methods of secondary transportation.
7. Statistics of present transportation, intensity of logging roads, and future demand.

Recommended Books:

1. Timber Cutting Practices by Conway, S. 1978, LCCCN0.78-53017
2. Principles of timber harvesting systems. By Conway, S. 1976

3. Logging Cost analysis by Mathews, 1980
4. Chain Saw in tropical forests. FAO teaching series,1980

Specialization (FEL-III) Applied Mechanics in Forestry

1. Forces: Laws of forces, analytical and graphical conditions of equilibrium for a system of current forces.
2. Parallel forces: Center of gravity, Reaction of supports of beams.
3. Framed Structure: Analysis of forces in determinate frames, graphical solution, work, Energy, Power, Mechanics for lifting weights. Diagram of work IHP and BHP.
4. Friction: Laws of Friction, Machines bearings, Journals and pivots, Inclined planes, Screws.
5. Velocity and acceleration diagram: Angular velocity and acceleration, change in velocity, motion in circle, SH motion, Relative velocity, motion in circle.
6. Inertia: Translatory and rotational, Kinetic energy, Momentum, Impulsive forces, Moment of Inertia, Centrifugal forces, Impact of Elastic bodies.
7. Transmission of Motion: By belts, Velocity ration of pulleys, fraction and HP transmitted.
8. By Ropes: Centrifugal tension in ropes and belts, by toothed wheels, Angular velocity ration, HP transmitted. Trains of wheels.

Recommended Books:

1. Applied mechanics by J. Duncan
2. Mechanics for Technology by Bruch C.D, John Wiley & Sons, Inc. 1976

11. ENVIRONMENTAL FORESTRY

(Specialization EF-I) Environment and Forestry

Objective:

To educate the students about the concept and importance of environmental forestry and management of forests for improvement of the environment.

Course Outline

1. Forests and Climate Control: Green house effect, forest and climatic change. Climatic change in Pakistan. Vegetation zones of Pakistan. Mountain and climate change.
2. Afforestation: Benefits of home and urban tree planting. Developing green belts in urban areas for improvement of environment.

3. Forest Fires and Control: Nature of forest fire, detection of forest fire, methods of control of forest fire by different mechanical and chemical methods and effects.
4. Impact of desertification and Control: Management and control of desertification, soil and water erosion, water logging and salinity, soil, water and air pollution, floods. Trees and noise
5. Importance of forests in protecting watersheds and providing clean water for drinking and controlling erosion, increasing life spans of water reservoirs through reduction of silt depositing in reservoirs and canal system, mitigating environmental pollution, sound and dust pollution.
6. Identification of tree species for improving environment in different zones.
7. Developing forest management plans for improvement of environment.

Practical

Field: Visit to study impact of forests on environment.

Lab: Develop forestry projects for different areas for improvement of environment.

Recommended Books

1. Centre for Applied Economics Studies (1989). Proceedings on "Problems of Environmental Protection in Pakistan". University of Peshawar in Collaboration with Federal Republic of Germany.
2. Desh Bandhu and N.L. Ramnathan (1982). Education for environmental planning and conservation. Natraj Publishing Co. Ltd., New Delhi.
3. Khoshoo, T.N. (1987). Perspective in Environmental Management, Indian Science Congress, Oxford and IBH Publishing Co. Ltd., New Delhi.
4. Govt. of Pakistan & IUCN: (1991) The Pakistan National Conservation Strategy. Environment and Urban Affair Division, GOP, Islamabad.
5. Sapru, R.K. (1987). Environmental Management in India. Vol.I and Vol.II. Ashosh Pub. Hon. New Delhi.

(Specialization EF-II) Environment Pollution and Mitigation Measures

Objective:

To equip the students with the knowledge of environmental pollution and the measures required for mitigation of pollution.

Course Outline

1. Concept of environmental pollution including contamination of air, soil and water.
2. Study causes of environmental pollution: industrial emission and waste, sewage systems, emission from vehicles, household waste, insecticide, brick kilns, etc.
3. Methods and techniques applied for measuring environmental pollution.
4. Negative effects of environmental pollution on economy and health.
5. Affects of environmental pollution on vegetation (acid rains and tree diseases).
6. Role of forests in mitigating environmental pollution.
7. Study technical, engineering and legal measures to reduce environmental pollution.

Practical

Field: Visit to study environmental pollution and its negative effects and learn the techniques to control environmental pollution.

Recommended Books

1. Brown, L.R., Brown, F.P. and Postel Sandra (1991): Saving the Planet: How to Shape an Environmentally Sustainable Global Economy Book Description, W. W. Norton & Company, USA.
2. Calver, Mike, Lymbery, A. and Comb, J.M. (2009). Environmental biology, Cambridge University Press, USA.
3. Maslin, Mark 2008: Global warming. Oxford University Press, USA

(Specialization EF-III) Environmental Impact Assessment (EIA)

Objective:

To equip the students with the techniques of Environmental Impact Assessment of applied to projects, town planning and industries.

Course Outline

1. Definition, concept and scope of EIA.
2. Using EIA in forestry and other projects. Procedures, guidelines and scoping in EIA.
3. EIA assessment standards applied for different activities (road construction, town planning, industries, dams construction, mining and oil drilling)
4. Instruments, equipment and methodologies of EIA.
5. Legal aspects of EIA for public and private projects.

Practical

Field: Visit to conduct EIA of different projects, towns and industries.

Recommended Books:

1. Concepts and Principles of Environmental Impact Assessment (EIA). EIA activities in the management of Forestry, Watershed, Rangelands, National Parks, Wildlife etc.
2. Govt. of Pakistan & IUCN: (1991) The Pakistan National Conservation Strategy. Environment and Urban Affair Division, GOP, Islamabad.
3. Sapru, R.K. (1987). Environmental Management in India. Vol.I and Vol.II. Ashosh Pub. Hon. New Delhi.
4. Shrivastara, A.K (2003): Environmental Impact Assessment. A.P.H. Publishing Corporation, 5, Ansari Road, Darya Ganj, New Delhi.
5. The World Bank (1991). Environmental Assessment Sourcebook. Vol.II (World Bank Technical Paper No.140.) Environment Department. The World Bank, Washington D.C.

(Specialization EF-IV) Environmental Policies and Laws

Objective:

To educate the students about national and provincial environmental laws and policies.

Course Outline

1. Study of national and provincial environmental policies and laws
2. Study the application of laws and regulations concerning disposal of wastes and emissions by industries and emission of gases and noise by vehicles.
3. Constraints and obstacles in implementing the environmental laws.
4. Strengths and weaknesses of Environmental Protection Agencies in implementing the laws.
5. How the environmental policies and laws could be made effective?

Practical

Field: Visit to Environmental Protection Agencies and study their activities concerning implementation of the laws.

Recommended Books

1. Brown, L.R., Brown, F.P. and Postel Sandra (1991): Saving the Planet: How to Shape an Environmentally Sustainable Global Economy Book Description, W. W. Norton & Company, USA.
2. Calver, Mike, Lybery, A. and Comb, J.M. (2009). Environmental biology, Cambridge University Press, USA.
3. Maslin, Mark 2008: Global warming. Oxford University Press, USA

12. FORESTRY AND CLIMATE CHANGE**FCC-I (Forest Carbon and Climate Change)****Objective**

This subject will investigate the role of forests in the carbon cycle and in a changing climate. Students will learn the scientific basis for climate change and the impact that a changing climate might have on tree physiology and forest ecology.

Course Outline

- Climate change: The role of CO₂ and other atmospheric trace gases
- Forest ecosystems as sinks and sources of trace gases
- Effects of climate change on forest ecosystems
- Forests and forest plantations in the global carbon cycle
- Carbon sequestration in forests: a mitigation option?
- Political responses to climate change all over the world.
- UNFCCC (UN framework convention on climate change) and Kyoto Protocol
- Carbon accounting schemes in forests and forest plantations
- Carbon accounting tools in hands-on sessions with industry partner

Practical

Visit to forest areas for assessment of carbon stocks and carbon sequestration in standing trees.

Recommended Books:

1. Brown, L.R., Brown, F.P. and Postel Sandra (1991): Saving the Planet: How to Shape an Environmentally Sustainable Global Economy Book Description, W. W. Norton & Company, USA.

2. Calver, Mike, Lymbery, A. and Comb, J.M. (2009). Environmental biology. Cambridge University Press, USA.
3. Maslin, Mark 2008: Global warming. Oxford University Press, USA

FCC-II (Clean Development Mechanism and Carbon Sequestration)

Objective

To educate the students about Clean Development Mechanism and Carbon Sequestration.

Course Outline

1. Kyoto Protocol and idea of Clean Development Mechanism (CDM) and Carbon Sequestration.
2. Certified Emission Reduction (CER) credits and its importance for developing countries.
3. Relationship between sustainable development and emissions reduction.
4. Emissions reductions through renewable energy, energy efficiency, and fuel switching
5. Development of projects for emission reductions and carbon sequestration.
6. Study of CDM and carbon sequestration projects.

Practical

Field: learn the techniques of CDM and carbon sequestration.

Recommended Books:

1. Boyd, E. et al (October 2007). "The Clean Development Mechanism: An assessment of current practice and future approaches for policy". Tyndall Centre for Climate Change Research.
2. Hepburn, C. (November 2007). "Carbon Trading: A Review of the Kyoto Mechanisms". *Annual Review of Environment and Resources*.

**FCC-III Trees in changing Climate /Functional
Tree Biology**

3(2-1)

Objectives

This subject will provide a broad understanding of functional tree biology. Modern forest science, ecology and management relies on tools and models based on functional parameters of trees, e.g. in forest growth modeling, estimating water use by forests, assessing risks by environmental extremes, quantifying carbon sequestration by forests. Graduation level forest scientists are expected to adequately and critically interpret such scenarios and outputs, a task that can only be achieved by the fundamental understanding of how the main forest resource – trees work.

Course Outline

- Fundamental processes of tree life and primary production - photosynthesis, respiration, nutrition
- Water relations and water use of trees
- Primary and secondary metabolism of trees
- Principles of tree-environment interactions (ecophysiology)
- Strategies used by trees to withstand adverse environmental conditions (stress physiology)
- The structure of trees in relation to associated functional aspects (growth, wood formation, water and nutrient uptake, environmental interactions)
- Overview of methods to measure the life functions of trees

Practical

Measurement of Photosynthesis, Stomata conductance, Leaf water potential, Transpiration Ascent of sap, Study of Anatomy of leaves, stems and root.

Recommended Books:

1. Sinha, S., S. Manisha and S. Ranjana. 2005. A text book of Environmental Studies. AITBS Publishers. India
2. Robert, M. D. 1999. Plant Physiology. Van Nostrand Reinhold Company. Melbourne Australia.
3. Dutta, A.C. 2006. A Class Book of Botany. 20th Edition. Satribari Road, Gauhati, Assam India

13. NON WOOD FOREST PRODUCTS

(Specialization NWFP-I) Production Technology of Medicinal Plants

1. Importance and scope
2. Classification of medicinal plants
3. Cultivation of medicinal plants:
 - Soil conditions, Solid phase, Liquid phase, Gaseous phase, Living phase, Organic Matter, Soil reaction, Soil profile, Soil water,
 - Land preparation for cultivation of medicinal plants:
 - Time of planting, Actual planting/sowing of crop, Depth of seeding, Ecological environment and soil impact, Climate, Soil fertility management, Irrigation and drainage, Plant maintenance and protection, Weed management, Cultural practices, Harvesting
4. Medicinal plants of Pakistan:
 - a. Medicinal herbs
 - b. Medicinal shrubs
 - c. Medicinal climbers
 - d. Medicinal trees
5. Propagation of medicinal plants:

Medicinal plants propagation methods, Seed as propagation material Propagation through nursery sowing, Handling of nursery seedlings, Irrigation in the nursery, Pest and disease control, Ventilation, Vegetative propagation, Propagation through cuttings, Types of cuttings, Stem cuttings, Hardwood cuttings, Semi-hardwood cuttings, Softwood cuttings, Herbaceous cuttings, Leaf cuttings, Leaf-bud cutting, Root cutting, Propagation through tubers, Propagation through suckers, Propagation through offsets, Undercutting seedbeds, Managing the propagation environment, Propagation structures, Sanitation in propagation
6. Conservation of medicinal plants:
 - Strategies and priorities
 - Conservation of medicinal plants
 - *In-situ* Conservation

Ex-situ Conservation
Germ-plasm collection and gene bank preservation

National parks and sanctuaries

- 7 Collection of medicinal plants:
Permission to collect, Management plan for collection, Information of the target species, Population density of medicinal plants, Quality of medicinal plants to be collected, Environmental information, Selection of medicinal plants for collection, Collection procedure of medicinal plants
- Suitable weather for collection
 - Suitable time of the day good for collection
 - Suitable season of collection
 - Proper tools for collection
 - Plant parts and proper stage of collection
 - Collection of leaves
 - Collection of buds
 - Flowers
 - Fruit and seeds
 - Bark
 - Collection of roots
 - Collection of tubers
 - Collection of bulbs
 - Cleaning and preparation of collected materials
 - Drying of collected materials
 - Outdoor drying
 - Indoor drying
 - Artificial drying
 - Storage of collected materials
 - Packing and labeling of collected materials
 - Personnel health, hygiene and sanitation
- 8 Poisonous plants of Pakistan
- 9 Registration of crop varieties

Recommended Books:

1. "Guidelines for cultivation, collection, conservation & propagation of medicinal herbs"(2006) by Dr. Muhammad Aslam Gil.
2. Hundred drug plants of Pakistan(1972) by M. B. Zaman
3. The Indian Materia Medica(1954) by Nadkarni
4. A pictorial guide to medicinal plants of Pakistan(2006) by Zabta Khan Shinwari.
5. Authenticity of folk medicinal plants of Pakistan by Aurangzeb Hassan, Mir Ajab Khan, Mushtaq Ahmad.

6. Cultivation of *Saussurea lappa*, *Mint cultivation in Pakistan*, *Atropa acuminata*, *Linum usitatissimum*, *Glycyrrhiza glabra*, *Curcuma domestica*, *Zingiber officinalis* by Muhammad Muslim, (2005-2008).

(Specialization NWFP-II) Pharmacognosy of Medicinal Plants

- The scope of Pharmacognosy
- Historical background and the drug trade
- Plant morphology and plant description
- Taxonomy and plant names
- Plant anatomy
- Plant cells
- Cell contents
- The cultivation of medicinal plants
- Plant Genetics
- The collection, drying and storage of drugs
- Insects and other pests in drugs

Phyto-chemistry:

- Introduction
- Acids
- Alcohols and ethers
- Carbohydrates
- Glycosides
- Alkaloids
- Volatile oils
- Vitamins, Hormones and antibiotics
- Examination of powdered drugs

Recommended Books:

1. A text book of Pharmacognosy(1951) by G. E Trease.
2. Pharmacographia indica(1972) by William Dymock.
3. Avicena's Canon of Medicine(1966) by Mazhar H. Shah.
4. Pharmacognostic studies of selected indigenous plants of Pakistan(1985) by Anwar Ahmad Khan.

(Specialization NWFP-III) Sericultural Techniques

Objective:

Introduce the non-wood uses of forests for sustainable forest resource management based on multiple uses of forests.

Course Outline

1. Silkworm rearing and its requirements
2. Rearing of early and late instar larvae
3. Mounting and cocoon spinning
4. Sexing and coupling
5. Cocoon harvesting and its treatment
6. Oviposition and fertility
7. Diseases of silkworm

Recommended Books:

1. Ganga, G. 2003. *Comprehensive Sericulture*. Volume II: Silkworm Rearing and Silk Reeling. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.

(Specialization NWFP-IV) APICULTURE

1. Honey bee species
2. Organization of honey bee colonies
3. Seasonal Management of honey bee colonies
4. Natural enemies of honey bees
5. Honey bee flora
6. By products of honey bee
7. Supplementary feeding of honey bee colonies
8. Migratory schedule of honey bee colonies
9. Basic equipment of bee keeping

Practical

1. Queen breeding method
2. Honey bee disease and predators, identification and control
3. Collection of bee products
4. Effect of supplementary feeding on colony development
5. Queen rearing, preparation of queen cells, grafting larvae

Recommended Books

1. Atkins, E.L. and Banker, R. 1978. *The Hive and the Honey bees*. Dadant & Sons.
2. Howes, F.N. 1979. *Plants and Bee Keeping*. Faber Paperbacks

(Specialization NWFP-V) Minor Forest Produce

1. Mazri
Habitat and distribution of Mazri
Silvicultural characteristics of Mazri
Nursery techniques
Afforestation and harvesting pattern
Economic aspects

- Balochistan Production in Khyber Pakhtunkhawa, FATA and
Marketing of Mazri
- Utilization
Processing facilities
Domestic use
Socio-economic impacts
Employment
Mazri control Act
2. Mushrooms
Morphology of Fungi
Importance of fungi for man and the living environment
Poisonous fungi and the symptoms of poisoning
Where and when to grow mushroom
How to collect and identify fungi
Development of the Mushroom industry
How mushrooms are grown commercially
Edible mushrooms, their collection and use
Crop management
Pest and diseases
3. Resin
Setting up the crop
Freshening and collection of resin
Methods of tapping
Manufacture of Turpentine oil
Uses of Resin and Turpentine
4. Gum
Description of Gum producing plants
Gum Arabic
Phulai gum

Practical:

1. Demonstration of cultivation of mushroom
2. Collection, preservation and identification of mushrooms for presentation in the examination.

Recommended Books:

1. Fred. C. Atkins. 1974. Guide to mushroom growing. Faber and Faber Ltd 3 Queen Square, London WC1.
2. Mirko Svrcek. The Himlyn Book of Mushrooms and Fungi. Hamlyn, London.
3. Muhammad Shabir Mughal 1991. Monograph on *Nannorrhops ritchiana* H. Wendl (Mazri). Pakistan Forest Institute, Peshawar.
4. Punjab Forest Leaflets No. 13. Resin Tapping Instructions and Rules.

(Specialization NWFP-VI) Economics of Non Wood Forest Products

1. Valuation of non wood forest products
2. Role of non-wood forest products in livelihood of forest dependent communities
3. Concepts of benefit-cost ratio
4. Marketing and its problem
 - a. Current status of markets
 - b. Supply potential
 - c. Regulations and quality requirements
 - d. Qualitative survey of different ecological zones of Pakistan
 - e. Quantitative survey of different drug markets of Pakistan
 - f. Medicinal plants and their potential as minor forest produce in Pakistan
 - g. Mechanism of marketing

Recommended Books:

1. Panayotou, T. and Ashton, P. 1992. *Not by Timber Alone: Economics and Ecology for Sustaining Tropical forests.* Washington: Island Press.
2. Handbook of Forestry (1994). Pakistan Agricultural Research Council, Islamabad.
3. Survey of crude drug markets in Pakistan by Anwar Ahmad Khan.

Practical

- Identification of medicinal plants
- Collection of medicinal plants
- Methods of propagation
- Drying methods
- Survey Techniques
- Microscopical Techniques
- Chromatography Techniques
- Physical methods of Analysis

1. FOREST MANAGEMENT PLAN -I

Objectives:

To impart in-depth knowledge about forest inventories, methodologies and preparation of working plans.

Theory

1. Working plan, Review, Impact and Need Assessment.
2. Procedure (Hierarchy) for working plan preparation.

3. Planning for working plan.
4. Sampling design used in forest inventories.
5. Inventory methods; continuous forest inventory, fixed area plot method and Prism or Point sampling.
6. Determining plot numbers, size and distribution in the forest, grid size calculations, conversion of forest map scales and representative factors.
7. Orientation of forest map.
8. Determining plot points. On plot measurements. Precautions in plot measurements.
9. Recording of data, tally sheets.
10. Present and future stand and stock tables.
11. Movement ratio and yield calculations using different formulas.

Recommended Book:

1. Carl A. S. 2009. Forest Management: Forest Working Plans : Guide to Lectures Delivered at Biltmore Forest School. Cornell University, USA.
2. Central Provinces (India) Forest Deptt. 2009. Working Plan For The Forests of The Bnajar Valley Reserve, South Mandla Forest Division. India.
3. P.W. West. 2009. Tree and Forest Measurement. Springer verlag.
4. M.P. Shiva. 1998. Inventory of Forest Resources For Sustainable Management and Biodiversity Conservation. Indus Publishing Company. India.
5. Osmaston, F.E. (1968). The Management of Forests. George Allan and Unwin Ltd., Ruskin House, Manchester, London.
6. Khattak, A.K. 1992. Development of a Model Forest Management Plan for Panjul Forest in Western Himalaya (Pakistan). LWF, LMU, Munich-Germany.

2. FOREST MANAGEMENT PLAN-II

Objectives:

To acquaint the students with preparation of working plan through forest inventory.

Practical

1. Sampling Intensity, Sampling Design, Fixed area plots methods.
2. Scale conversions of Forest maps. Grid preparation. Collection of socio economic data.
3. After conducting the inventory of the forests each group of students have to prepare the working plan of the given forests providing following (Format) information:

The forest tract to deal with: Name and Situation, configuration of ground, Geology, soil type, State of boundary, Legal positions, Rights and concession.

The forest: Species Composition, Injuries liable to forest.

Utilization of Produce: Agricultural crops, Market of the products.

Staff and Labour supply: availability of labour

Past system of Management: Statistics of Growth and Yield

Basis of Proposal: National Forest Policy, General objectives of Forest Management, Working circles, Blocks and compartments. Period of Plan, Allocation of working circles in the forest.

Miscellaneous Regulation: Petty felling, Fire Protection, Maintenance of Boundaries.

Financial Forecasts: Budget allocation, Control and Maintenance of records.

Recommended Book

1. Carl Alwin Schenck. 2009. Forest Management: Forest Working Plans: Guide to Lectures Delivered at the Biltmore Forest School. Cornell University, USA.
2. Central Provinces (India) Forest Deptt. 2009. Working Plan For The Forests Of The Bnajar Valley Reserve, [south]-mandla Forest Division. India.
3. P.W. West. 2009. Tree and Forest Measurement. Springer verlag.
4. M.P. Shiva. 1998. Inventory Of Forest Resources For Sustainable Management and Biodiversity Conservation. Indus Publishing Company. India.
5. Osmaston, F.E. (1968). The Management of Forests. George Allan and Unwin Ltd., Ruskin House, Manchester, London.
6. Tabassum, A. 2002. Working Plan of Forest College Murree. Pakistan Forest Institute. Peshawar.

3. RESEARCH METHODS AND SCIENTIFIC WRITING

Objective:

To educate students for preparing research proposal, conducting research and to develop scientific writing skills.

Theory:

1. Definition and concept of research
2. Concepts and types of Plagiarism and its consequences.
3. Funding sources and developing a format for seeking research grants
4. Selection of research topic, understanding the problems to be solved.
5. Review of literature.
6. Objectives of research projects.
7. Materials involved, methods and approach in handling of projects;
8. Data collection, Data Analysis and Interpretation by using modern statistical packages.
9. Preparing manuscripts for publications.

Recommended Books:

1. Anonymous. 2002. A Step-by-Step Guide for Bio-Medical Scientists (2nd Ed.) Cambridge University Press.
2. Day, R. A. 1983. How to Write and Publish a Scientific Paper. ISI Press. Philadelphia.
3. Bhatti, I.A. Elementary Statistics. Bhatt, Publishers, Jehlum.
4. Chaudhry, S.M. (1985). Introduction to Statistical Theory (Part I & II) Ilmi Kitab Khana, Lahore.
5. Erwin L. LeClerg, et al (1965). Field Plot Technique U.S.A. Library of Congress catalog No. 62-16455.
6. Fielding, J and Gilbert, N (2006), *Understanding social statistics*, London: Sage. (2nd Edition)
7. Frease, Frank. (1981) Elementary Statistical Methods for Foresters. USDA Forest Service Handbook No.317.
8. Hussain, R.W. and M.I. Sheikh (1988). A guide book for Forestry Research, PFI, Peshawar.
9. Kinner, P. (2006) *SPSS 14 Made Simple*. New York: Psychology Press
10. Pallant, J. (2005). *SPSS Survival Manual: A step by step guide to data analysis using spss2nd Edition*. Glasgow: Bell and Bain Ltd.
11. Plutchick, R. 1974. Foundations of Experimental Research. Harper & Row, London.
12. Matthews, J.R., J.M. Brown and R.W. Matthews. 2000. Successful Scientific Writing: Mc Graw Hills.

RECOMMENDATIONS

Following recommendations were given by the participant of the meeting.

1. As recommended by the HEC in light of previous scheme of studies some new books have been added in this scheme and efforts should be made to provide the latest books time to time.
2. The National Curriculum Revision Committee (NCRC) recommends that experts in the field of forestry should write monograph and text books under the HEC funded scheme for publication.
3. Forestry is an applied professional discipline therefore physical training and field visit should be integral part of forestry education. Therefore, HEC should inform universities/ institution administration that field visit are the core of Forestry Education so students should be facilitated for as many tours as possible.
4. An Accreditation Council for Forestry degree in Pakistan should be established to ensure uniformity and quality standards in all departments/ institutes offering Forestry degree(s) at graduate and Post-graduate level.
5. To ensure the quality of education in forestry, monitoring of the required facility in class room, lab, and equipment should be carried out on regular basis by HEC.
6. Adequate funds and facilities in laboratories for equipment, chemicals, etc. should be made available. Special development funds should be provided on priority basis to strengthen newly established Forestry Departments in different Universities.
7. Teachers training should be organized by HEC on important issues like forest certification, climate change, GIS, CDM and REDD+.
8. Regional orientation workshops should be organized by HEC for faculty members regarding scheme of studies for BS Forestry / B.Sc (Hons.) Agriculture Major in Forestry.
9. HEC should request provincial forest departments for providing possible facilities for conducting research in natural forests and plantations.

10. Pakistan Forest Institute (PFI) will adopt the revised curriculum alongwith other institutions, but to cater for requirement of provincial / regional governments and other organizations, it will continue with the existing B.Sc and M.Sc Forestry programs of two years each for maximum up to the next two years