

Restructured and Revised Syllabus of PG Programme
M.Sc. FORESTRY IN FOREST PRODUCT & UTILIZATION
Course Contents

Semester 1					
Code	Title	Theory	Internal	Practical/ Term Paper	Total
Major Courses					
SOA/FCMC/501	Non Wood Forest Products Management	60(2)	20	20(2+1)	100(3)
SOA/FCMC/502	Applied Wood Technology	60(2)	20	20(2+1)	100(3)
SOA/FCMC/503	Pulp and Paper Technology	60(2)	20	20(2+1)	100(3)
SOA/FCMC/504	Composite Wood Technology	60(2)	20	20(2+1)	100(3)
Supporting Course					
SOA/FESC/511A	General Statistical Methods and Computer Application	60 (2)	20	20 (2+1)	100 (3)
Common Courses					
SOA/FECC/01	Library and Information Services	-	40	60 (0+1)	100 (1)
SOA/FECC/02	Technical Writing & Communication Skills	-	40	60 (0+1)	100 (1)
SOA/FECC/03	Intellectual Property & Its Management in Agriculture	60	40	- (1+0)	100 (1)
SOA/FECC/04	Basic Concepts in Laboratory Techniques	-	40	60 (0+1)	100 (1)
SOA/FECC/05	Agricultural Research, Research Ethics & Rural Development Programmes	60	40	- (1+0)	100 (1)
Total Marks and Credits					1000 (20)
Semester II					
Major Courses					
SOA/FCMC/505	Forest Products Laboratory Techniques	-	40	60 (0+2)	100 (2)
SOA/FCMC/506	Agro-techniques of Medicinal and Aromatic Crops	60	20	20 (2+1)	100 (3)
SOA/FCMC/508	Chemistry and Processing of Medicinal & Aromatic Plants	60	20	20 (2+1)	100 (3)
Minor Courses					
SOA/FEMC/01	Silviculture	60	20	20 (2+1)	100 (3)
SOA/FEMC/02	Forest Biometry	60	20	20 (1+1)	100 (2)
SOA/FEMC/03	Agroforestry System	60	20	20 (2+1)	100 (3)
Supporting Courses					
SOA/FCSC/511B	Experimental Designs	60	20	20 (2+1)	100 (3)
Total Marks and Credits					700 (19)
Semester III					
SOA/FCMC/509	Wood Identification	-	40	60 (0+2)	100 (2)
SOA/FCMC/510	Chemistry of Forest Products & Industries	60	20	20 (2+1)	100 (3)
SOA/FCMC/513	Wood Seasoning and Preservation	60	20	20 (2+1)	100 (3)
SOA/FCMC/514	Production of Medicinal & Aromatic Crops	60	20	20 (1+1)	100 (2)
SOA/FCMC/591	Master's Seminar	-	-	100 (1)	100 (1)
SOA/FCMC/599A	Research Review (Master Thesis)	-	-	100 (7)	100 (7)
Total Marks and Credits					600 (18)
Semester IV					
SOA/FEMC/513	Medicinal & Aromatic Plants in Health Care System	60	40	- (2+0)	100 (2)
SOA/FEMC/514	Pharmacognosy of Medicinal and Aromatic Plants	60	20	20 (1+1)	100 (2)
SOA/FE/599B	Master's Research (Thesis)	-	-	100 (23)	100 (23)
Total Marks and Credits					300 (27)

SEMESTER – I

MAJOR COURSES

SOA/FCMC/501 - NON WOOD FOREST PRODUCTS MANAGEMENT

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Non Wood Forest Products Management	SOA/FCMC/501	2+1	60	20	20	100 (3)

IV – Aim of the Course

To make students to understand and learn about the different non wood Forest Products and their scientific extraction, processing and disposal.

V – Theory

Unit – I

Classification of non wood forest products like gums and resins, katha, dyes, tannins, oils, raw drugs, bamboos, canes and other products.

UNIT II Technologies for extraction of gums, resins, katha, dyes, tannins, oils, raw drugs and other products.

UNIT III Utilization of various non wood forest products and their scientific management for processing, value addition, marketing and disposal.

UNIT IV Quality assessment of important products and their methods for storage. Important industries based on non wood forest products and their management.

VI. Practical

- Extraction of resins, gums, katha, dyes, tannins, oils raw drugs, bamboos, canes and other products;
- Value addition techniques for these products;
- Visit to non wood forest products based industries.

VII. Suggested Reading

- Linskens HF and Jackson JF. 1991. Essential Oils and Waxes (Ed.). Springer-Verlag Berlin Heidelberg.
- Mathe A. 2015. Medicinal and Aromatic Plants of the World-Scientific, Production, Commercial and Utilization Aspects. Springer Netherlands.
- Panda H. 2005. Hand Book on Specialty Gums, Adhesive, Oils, Rosin And Derivatives, Resins, Oleoresins, Katha, Chemicals with others Natural Products. Asia Pacific business press. Inc.
- Panshin AJ, Harrer ES and Bethel JS. Forest Products, their Sources, Production and Utilization.
- Shackleton S, Shackleton C and Shanley P. 2011. Non-Timber Forest Products in the Global Context (Ed.). Springer, Verlag Berlin Heidelberg.

SOA/FCMC/502 - APPLIED WOOD TECHNOLOGY

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Applied Wood Technology	SOA/FCMC/502	2+1	60	20	20	100 (3)

IV - Aim of the Course

To acquaint students with various aspects of wood technology and their role in different applications.

V – Theory

UNIT I

Physical properties of wood-wood density, specific gravity and methods of their determination. Effect of growth on density of wood. Moisture content and its measurement. Effect of sound on wood resonance. Color of wood, phosphorescence, fluorescence and residual luminescence. Thermal properties-conductivity and diffusivity. Electrical properties-conductivity, dielectric constant and current resistivity. Wood permeability.

UNIT II

Mechanical properties-elastic constants, plasticity, Hook's Law, Poisson's ratio, elastic constants, modulus of elasticity, factors affecting strength properties, elastic theory of bending, shear stresses in simple beams, supported beams and cantilevers carrying concentrated and uniformly distributed loads, direct and bending safe working stresses and their evaluation.

UNIT III

Standard tests of timber specimen's-compression, tensile strength. Mechanics and Rheology of wood, abrasion, brittleness and hardness. Suitability coefficient and indices of different wood species. Vibration properties.

UNIT IV

Effect of environment on mechanical properties of wood. Effect of radiations on strength of wood.

VI – Practical

- Determination of density, specific gravity, strength, hardness, modulus of elasticity, mechanical properties, thermal conductivity, electrical resistivity and dielectric constant of important domestic and imported timber species.

Suggested Readings

- Bodig J and Benjamin AJ. 1993. Mechanics of Woods and Woods Composites. Krieger Publish Company.
- Brown HP. 1925. An Elementary Manual on Indian Wood technology. Central Publication Branch, Government of India, Calcutta.
- Brown HP. 1985. Manual of Indian Wood Technology. International Books and Periodicals Supply Service, New Delhi.
- Hill CAS. 2006. Wood Modification: Chemical, Thermal and other Processes. John Wiley and Sons Ltd.
- Hoadley B. 2000. Understanding Wood: A Craftsman's Guide to Wood Technology. Taunton Press. Newtown, USA.
- Kollmann FFP and Cote WAJ. 1968. Principle of Wood Science and Technology. Vol I, Solid wood. George Allen and Unwin Ltd London, Springer-Verlag, Berlin, Heidelberg, New York.
- Panshin AJ and De ZC. 1980. Textbook of Wood Technology, 4th Ed. McGraw-Hill. New York.

SOA/FCMC/503 - PULP AND PAPER TECHNOLOGY

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Pulp and Paper Technology	SOA/FCMC/503	2+1	60	20	20	100 (3)

IV - Aim of the Course

To acquaint the students with the resources and processes for making pulp and paper.

Theory
UNIT I Raw material used in pulp and paper industries, characteristics and handling.
UNIT II Pulping process, mechanical, chemical, semi-chemical and bio-pulping. Pulp bleaching, pulp treatment, de-fibering, de-knotting, brown stock washing, screening, cleaning, thickening, etc.
UNIT III Recycled fibers, supplementary pulp treatment and additives. Paper making, paper drying, reeling, external sizing, coating, calendaring, etc.
UNIT IV Structure of paper, its characterization and measuring strength method, optional and structural properties of paper, Type of paper: coated paper, corrugated containers, printing quality of paper, ageing of paper. Rayon industry.
Practical
<ul style="list-style-type: none"> • Visit to pulp and paper industry; • Study of raw materials, techniques and pulp yield, making of paper and its quality determination.
Suggested Reading
<ul style="list-style-type: none"> • Asuncion J. 2003. The Complete Book of Paper Making. Lark books, New York. • Bajpai P. 2018. Biermann's Handbook of Pulp and Paper. Vol. 1st:Raw material and pulp making. Elsevier Science, UK. • Biermann C. 1996. Handbook of Pulping and Paper Making. 2nd Ed. Academic Press San Diego, New York, Boston, London, Sydney, Tokyo, Toronito. • Britt KW. 1970. Handbook of Pulp and Paper Technology. 2nd Ed. Van Nostrand Reinhold Company, New York. • Lavigne JR. 1979. Instrumentation Applications for the Pulp and Paper Industry. Miller Freeman Publications. • Rao KP. 2007. Pulp and Paper Technology: Technology, Testing and Applications. CBS Publishing and Distributors, New Delhi. • Sjostrom E and Alen R (Eds). 1999. Analytical Methods in Wood Chemistry Pulping and Paper Making. Springer Series in Wood Science. • Viikari L and Lantto R. 2002. Progress in Biotechnology. Vol. 21st. Biotechnology in the pulp and paper industry. 1st Ed. ICBPPI. Elsevier Science

SOA/FCMC/504 - COMPOSITE WOOD TECHNOLOGY

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Composite Wood Technology	SOA/FCMC/504	2+1	60	20	20	100 (3)

IV – Aim of the Course
To impart knowledge regarding the scope and processes for developing composite and modified woods.

V – Theory
UNIT I Introduction to wood modification, its need and scope. Chemical modification of wood (acetylation, reaction with isocyanates, acetates, ethers, epoxides, etc.) Wood impregnation and compregnation, heat stabilization, wood densification.
UNIT II Modern trends in composite wood. Wood adhesives – types, characteristics and application.
UNIT III Plywood, laminated wood and inorganic wood composites- their manufacture, characteristics and application

VII – Practical

- Use of different adhesives in plywood;
- Study of composite boards, study of anti-shrink efficiency of wood treated with different chemicals;
- Impregnation and compregnation of wood with chemicals.

VIII – Suggested Reading

- Ansell MP. 2015. Wood Composites. Elsevier, Science and Technology.
- Hill CAS. 2006. Wood Modification: Chemical, Thermal and Other Processes. John Wiley and Sons Ltd.
- Pizzi A and Mittal KL. 2011. Wood Adhesives. CRC Press, New York.
- Rowell RM. 2013. Handbook of Wood Chemistry and Wood Composites. 2nd Ed. CRC Press, New York.
- USDA (U.S. Department of Agriculture). 1999. Wood Handbook: Wood as an Engineered Material. US Department of Agriculture, Forest Service. Forest Products Laboratory, Madison, WI.

SUPPORTING COURSES**SOA/FESC/511A – GENERAL STATISTICAL METHODS AND COMPUTER APPLICATION**

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
General Statistical Methods and Computer Application	SOA/FESC/511A	2+1	60 (2)	20	20	100 (3)

IV – Aim of the Course

This course is meant for students who do not have sufficient background of statistical methods. The students would be exposed to concepts of general statistical methods and statistical inference that would help them in understanding the importance of statistical methodology. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation of results.

Theory**Unit I**

Review of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions, viz., Binomial, Poisson and Normal distributions.

Unit II

Correlation and regression, Rank correlation, Non-linear regression, Partial and multiple correlation coefficient, Intra class correlation, Multiple linear regression.

Unit III

Introduction to theory of estimation, Testing of statistical hypothesis: chi-square, t and F distributions. Tests of significance based on chi-square, t and F tests. Large sample tests, Fisher Z transformation.

Unit IV

Analysis of variance: One way and two way classification. Design of Experiments: Basic Principles of design of experiments, Completely Randomised Design, Randomised Block Design, Latin Square Design. Elementary idea of factorial experiments. Estimation of genetic parameters from ANOVA table.

Unit V

Non-parametric tests: Sign test, Wilcoxon test, Mann-Whitney U-test, Wald Wolfowitz run test, Median test, Kruskal-Wallis test. MS Excel, Introduction to computer softwares.

Practical

- Random variable and mathematical expectation;

- Fitting of distributions, viz., Binomial, Poisson, Normal;
- Correlation and regression;
- Non-linear regression;
- Multiple linear regression;
- Testing of hypothesis based on chi square, t and F tests. Large sample tests. Completely Randomised Design, Randomised Block Design, Latin Square Design and Factorial experiments. Non-parametric tests. Exercises based on computer software.

Suggested Reading

- Aggarwal BL. 1996. Basic Statistics. Wiley Eastern Limited, New Age International Ltd.
- Bansal ML, Singh S, Singh TP and Kumar R. 2004. Statistical Methods for Research Workers. Kalyani Publishers.
- Chandel SRS. 2014. A Handbook of Agricultural Statistics. Achal Prakashan.
- Goon AM, Gupta MK and Dasgupta B. 1968. Fundamentals of Statistics, vol I, II. The World Press, Calcutta.
- Snedecor GW and Cochran WG. 1980. Statistical Methods. East West Press.

COMMON COURSES

SOA/FECC/01 – LIBRARY AND INFORMATION SERVICES

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Library and Information Services	SOA/FECC/01	0+1	-	40	60	100 (1)

IV. Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; er-esources access methods.

SOA/FECC/02 -TECHNICAL WRITING AND COMMUNICATIONS SKILLS

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Technical writing and communications skills	SOA/FECC/02	0+1	-	40	60	100 (1)

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;

- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.;
- Commonly used abbreviations in the theses and research communications;
- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings

1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
3. Collins' Cobuild English Dictionary. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
7. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
8. Mohan K. 2005. Speaking English Effectively. MacMillan India.
9. Richard WS. 1969. Technical Writing.
10. Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
11. Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

SOA/FECC/03 -INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Intellectual Property and its Management in Agriculture	SOA/FECC/03	1+0	60	40	No Practical	100 (1)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

1. Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
5. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
6. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House. The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

SOA/FECC/04 - BASIC CONCEPTS IN LABORATORY TECHNIQUES

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Basic Concepts in Laboratory Techniques	SOA/FECC/04	0+1	-	40	60	100 (1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

SOA/FECC/05 - AGRICULTURAL RESEARCH, RESEARCH ETHICS & RURAL DEVELOPMENT PROGRAM.

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Agricultural Research, Research Ethics & Rural Development Program.	SOA/FECC/05	1+0	60	40	No Practical	100 (1)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory**UNIT I**

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
4. Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

SEMESTER II**MAJOR COURSES****SOA/FCMC/505 – FOREST PRODUCTS LABORATORY TECHNIQUES**

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Forest Products Laboratory Techniques	SOA/FCMC/505	0+2	--	40	60	100 (2)

IV – Aim of the Course

To expose the students to the practical aspects of laboratory techniques employed in forest products.

V – Practical

- Wood and non-wood product sampling, drying and storage. Estimation of extraneous components of wood. Analysis of

volatile compounds;

- Estimation of chemical composition of wood samples (hardwoods, softwood and other lignocellulosic material) and ash;
- Separation of components by column, paper, and thin layer chromatography. HPLC techniques;
- Determination of strength properties of paper and wood composites.

VII – Suggest Reading

- Meyland BA and Butterfield BG. 1972. Three-Dimensional Structure of Wood: A Scanning Electron Microscope Study. Syracuse University Press.
- Rowell RM. 2013. Handbook of Wood Chemistry and Wood Composites. 2nd Ed. CRC Press, New York.
- Skaar C. 1988. Wood-Water Relations. Springer Series in Wood Science.
- Snyder LR, Kirkland JJ and Glajch JL. 2012. Practical HPLC Method Development. 2nd Ed. John Wiley & Sons.

SOA/FCMC/506 - AGRO-TECHNIQUES OF MEDICINAL AND AROMATIC CROPS

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Agro-techniques of Medicinal and Aromatic Crops	SOA/FCMC/506	0+2	60	20	20	100 (3)

IV – Aim of the Course

To equip the student with the conventional and commercial production techniques of medicinal and aromatic plant species.

V – Theory

Unit I

Importance of medicinal and aromatic plants in human health, national economy and related industries. Need of cultivation of medicinal and aromatic plants as agricultural crops. Concept of organic farming, GACP and GAP in medicinal and aromatic crops production. Quality concern in plant based drugs.

UNIT II

Introduction and importance, climate and soil requirements, cultural practices, harvesting and yield, important constituents of medicinal plants – *Mulhathi, Senna, Gloriosa superba, Valeriana jatamansi, Swertia chirayita, Isabgol, Rauwolfia serpentina, Withania sominifera, Opium Poppy, Aloe vera, Satavar, Stevia rebaudiana, Safed Musli, Kalmegh* and other important species of the region.

UNIT III

Introduction and importance, climate and soil requirements; cultural practices; harvest and yield; important constituents of aromatic plants – *Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Tagetes minuta, Lavender, Rosemary, Patchouli, Geranium* and other important species of the region.

VI – Practical

- Morphological identification of listed plants and their economic parts, maturity indices;
- Preparation and layout of nursery and field, methods of seed sowing/ transplantation, cultural operations in MAP crops;
- Raising and harvesting of at least one crop grown in the region;
- Visit to government and private Pharmaceutical units/ Institutes in adjoining areas;
- Visit to large scale herb growing and processing units engaged in commercial cultivation and preparation of purified phytochemical/ standardized extracts;

- Visit to nearby marketing/ trade centres.

Suggested Reading

- Atul CK and Kapur BK. 1982. Cultivation and Utilization Of Medicinal Plants. RRL, CSIR, Jammu-Tawi.
- Chadha KL and Gupta R. 2006. Advances in Horticulture. Vol. XI. Medicinal and aromatic plants. Malhotra Publishing House.
- Chopra AK. 2007. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books. Chopra RN. Nayar SL and Chopra IC. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi.
- EIRI Board. 2007. Handbook of Medicinal and Aromatic Plants: Cultivation, Utilization and Extraction Processes. Engineers India Research Institute, New Delhi.
- Gunther E. 1975. The Essential Oils. Robert, K Krieger Pub. Co, New York.
- Khan IA and Khanum A. 2005. Medicinal and Aromatic Plants of India; Herbal Wealth for Human Health. 1st Ed. Ukaaz Publications.
- Muralia S. 2006. Medicinal and Aromatic Plants 1st Ed. Neha Publishers and Distributors.

SOA/FCMC/508 - CHEMISTRY AND PROCESSING OF MEDICINAL AND AROMATIC PLANTS

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Chemistry and Processing of Medicinal and Aromatic Plants	SOA/FCMC/508	2+1	60	20	20	100 (3)

IV – Aim of the Course

To understand the chemistry of phyto-pharmaceuticals and their processing as industrial products.

V – Theory

UNIT I

Organic compounds and their classification such as aliphatic, aromatic, alkaloids, steroids, terpenoids, glycosides, phenolic compounds, heterocyclic compounds and carbohydrates.

UNIT II

Primary and Secondary plant metabolites and their therapeutic uses of phyto-constituents such as anthraquinones, steroidal and triterpenoidal glycosides, phenolic compounds, lipids, alkaloids and terpenoids.

UNIT III

Basic principles and extraction techniques of different phyto-constituents. Analysis of active principles using TLC, HPLC, Gas chromatography, etc. Quality standards in herbal products. Drug descriptors for medicinal and aromatic plants.

UNIT IV

Postharvest processing-drying, grading and storage. Extraction techniques of essential oils and their quality analysis.

VI – Practical

- Use of thin layer and column chromatography during extraction and purification of phyto-pharmaceuticals;
- Preparation of active constituent enriched extracts;
- Extraction of Essential oils and their quality evaluation;
- Preparation of concretes and absolutes. Use of HPLC and GC in quality evaluation.

Suggested Reading

- Bedi S, Singh T and Vyas SP. 2012. A Handbook of Aromatic and Essential Oil Plants: Cultivation, Chemistry, Processing and Uses. Agrobios (India).
- Finar IL. 2002. Organic Chemistry. Vol. I & II. Pearson Education India.
- Raaman N. 2006. Phytochemical Techniques. New India Publishing Agency, N. Delhi.
- Singh MP and Panda H. 2005. Medicinal Herbs with their Formulations. Vol-1st. Daya Publishing House.

- Singh S. 2009. Essentials of Pharmacology. 2nd Ed. New Age International Publisher.
- Wagner H and Blatt S. 2009. Plant Drug Analysis- A Thin Layer Chromatography Atlas. Springer (India) Pvt. Ltd.

MINOR COURSES

SOA/FEMC/01– SILVICULTURE

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Silviculture	SOA/FEMC/01	2+1	60	20	20	100 (3)

IV – Aim of the Course

To understand stand growth, development and provide knowledge regarding the application of silvicultural principles for the production and protection benefits from the forests.

V – Theory

Unit I

Forest ecosystems- Introduction to tropical/ temperate silviculture. Role of silviculture in forest and wild land management, major forest formations classification, distribution, composition and structure. Vegetation dynamics-species richness-diversity indices. Vegetation forms of India and their productivity. Forest ecosystem- structure and functioning, community development, competitive interactions in forest communities, forest succession, concepts and models of succession-Connell-Slatyer models, climax theories, tolerance.

Unit II

Ecophysiology of tree growth- effect of radiation and water relationship, mineral nutrients and temperature. Forest stand development – stand development, even aged and uneven-aged stands, age and site quality. Tree architecture and its role in stand management.

Unit III

Stand density determination-stand density indices-stand density management density management diagram, silvicultural treatments involved- thinning as a stand management tool, objectives of thinning, effects on growth and yield, thinning effect on economic yield of stands. Forest site quality evaluation-direct and indirect methods.

Unit IV

Treatment analysis-silvicultural regimes- factors influencing choice of regimes, use of system analysis to determine regimes, models for evaluating silvicultural alternatives, development of silvicultural regimes to suit management objectives, optimum management strategies, silvicultural prescriptions for maximum production regime.

VI – Practical

- Visit to forest areas to study forest composition, classification, factors of locality, site quality, form and growth of forest trees- study plant succession- study stand density, changes on productivity- thinning effects;

Suggested Reading

- Daniel TW, Helms JA and Baker FS. 1979. Principles of Silviculture. McGraw-Hill Book Company.
- Julius E. 1992. Plantation Forestry in the Tropics. Oxford University Press.
- Khanna LS. 1996. Principle and Practice of Silviculture. International Book Distributors.
- Khanna LS. 2015. Theory and Practice of Indian Silviculture Systems. Bio-Green Publisher.
- Lamprecht. 1986. Silviculture in the Tropics. Verlag Paul Parey, Hamburg und Berlin.
- Nyland RD, Laura S, Kenefic, Kimberly K, Bohn and Susan LS. 2016 Silviculture: Concepts and Applications (III edition), Kindle Edition, USA.
- Pascal. 1988. Wet Evergreen Forests of the Western Ghats.
- Shepherd KR. 1986. Plantation Silviculture. Springer.
- Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. The Practices of Silviculture- Applied Forest Ecology. John Wiley

SOA/FEMC/02 – FOREST BIOMETRY

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Forest Biometry	SOA/FEMC/02	1+1	60	20	20	100 (3)

IV – Aim of the Course

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

V – Theory

Unit I

Measurement of tree parameters. Determination of tree age and dendrochronology for growth history and climate change studies.

Unit II

Estimation of volume, growth and yield of individual tree and forest stands. Preparation of volume tables. Application of yield and stand tables.

Unit III

Forest inventory, sampling methods adopted in forestry, Use of GIS in forest inventory. Quantification of regeneration and stand establishment. Measurement of crown density and crown ratios. Simulation techniques. Growth and yield prediction models – their preparation and applications.

VI – Practical

- Calculations of volume of felled as well as standing trees;
- Volume table preparation;
- Application of different sampling methods;
- Preparation of yield and stand table;
- Quantification of regeneration and stand establishment;
- Measurement of crown density and crown ratios;
- Crown profiling of trees and stand;
- Dendrochronological studies.

Suggested Reading

- Chaturvedi AN and Khanna LS. 1994. Forest Mensuration. International Book Distributor.
- Ram Parkash 1983. Forest Surveying. International Book Distributor.
- Sharpe GW, Hendee CW and Sharpe WE. 1986. Introduction to Forestry. McGraw-Hill.
- Simmons CE. 1980. A Manual of Forest Mensuration. Bishen Singh Mahender Pal Singh, Dehradun.

SOA/FEMC/03 – AGROFORESTRY SYSTEMS

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Agroforestry Systems	SOA/FEMC/03	2+1	60	20	20	100 (3)

IV – Aim of the Course

To impart knowledge on the concept of agroforestry as a sustainable land use including diagnosis and design methodologies; overview of agroforestry and case studies.

V – Theory

Unit I

Agroforestry: objectives, importance, potentials and limitations for implementations. Land capability classification and land evaluation. Basis of classification of agroforestry systems and principles, indigenous vs. exotic, intraspecific variations, crown architecture of tropical/ temperate trees. Ideotype concept for selection of multipurpose trees. Nitrogen fixing trees. Overview and case studies of different agroforestry systems.

Unit II

Structural and functional attributes of agroforestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, silvopastoral systems, shelter-belts and windbreaks, energy plantations and home gardens.

Unit III

Role of trees in soil productivity and conservation– micro-site enrichment- litter and fine root dynamics, Nitrogen fixation and nutrient pumping. Soil productivity and management in agroforestry.

Unit IV

Community forestry and social forestry, linear strip plantations.

Unit V

Trends in agroforestry systems research and development, Diagnosis and Design –PRA-RRA tools in agroforestry problem diagnosis.

Unit VI

Climate Change mitigation and adaptation through agroforestry- climate negotiations- LULUCF- agroforestry options.

VI – Practical

- Survey and analysis of land use systems in the adjoining areas;
- Study of tree crown architecture;
- Design and plan of suitable models for improvement;
- PRA-RRA tools in agroforestry problem diagnosis.

Suggested Reading

- Buck LE, Lassoie, Fernandes ECM 1999. Agroforestry in Sustainable Agri. Systems. CRC Press.
- Kumar BM and Nair PKR. 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Springer publication.
- Kumar BM and Nair PKR. 2013. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and Challenges (Advances in Agroforestry). Springer publication.
- Nair PKR and Latt 1998. Directions in Tropical Agroforestry Research. Kluwer. Nair PKR, Rai MR and Buck LE. 2004. New Vistas in Agroforestry. Kluwer
- Nair PKR. 1993. An Introduction to Agroforestry. Kluwer Academic Pub.
- Ong CK and Huxley PK. 1996. Tree Crop Interactions – A Physiological Approach. ICRAF.
- Peter Huxley. 1999. Multiple Cropping with Woody and Non-Woody Plants. John Wiley and Sons Ltd, Oxford, United Kingdom.
- Tejwani KG. 1994. Agroforestry in India. Oxford & IBH Publishing Co. Pvt Ltd.
- Thampan PK. 1993. Trees and Tree Farming. Peekay Tree Crops Development Foundation.
- Young A. 1997. Agroforestry for Soil Management. CABI.

SUPPORTING COURSES

SOA/FCSC/511B - EXPERIMENTAL DESIGNS

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Experimental Designs	SOA/FCSC/511B	2+1	60	20	20	100 (3)

IV - Aim of the Courses

This course is meant for students who do not have sufficient background of statistical methods. The students would be exposed to concepts of general statistical methods and statistical inference that would help them in understanding the importance of statistical methodology. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation of results.

V – Theory

Unit I

Analysis of variance: One way and two way classification. Design of Experiments: Basic Principles of design of experiments, Completely Randomised Design, Randomised Block Design, Latin Square Design. Elementary idea of factorial experiments. Estimation of genetic parameters from ANOVA table.

Unit II

Non-parametric tests: Sign test, Wilcoxon test, Mann-Whitney U-test, Wald Wolfowitz run test, Median test, Kruskal- Wallis test. MS Excel, Introduction to computer softwares.

VI. Practical

- Random variable and mathematical expectation;
- Fitting of distributions, viz., Binomial, Poisson, Normal;
- Correlation and regression;
- Non-linear regression
- Multiple linear regression;
- Testing of hypothesis based on chi square, t and F tests. Large sample tests. Completely Randomised Design, Randomised Block Design, Latin Square Design and Factorial experiments. Non-parametric tests. Exercises based on computer software.

VII. Suggested Reading

- Aggarwal BL. 1996. Basic Statistics. Wiley Eastern Limited, New Age International Ltd.
- Bansal ML, Singh S, Singh TP and Kumar R. 2004. Statistical Methods for Research Workers. Kalyani Publishers.
- Chandel SRS. 2014. A Handbook of Agricultural Statistics. Achal Prakashan.
- Goon AM, Gupta MK and Dasgupta B. 1968. Fundamentals of Statistics, vol I, II. The World Press, Calcutta. Snedecor GW and Cochran WG. 1980. Statistical Methods. East West Press.

SEMESTER III

SOA/FCMC/509 – WOOD IDENTIFICATION

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Wood Identification	SOA/FCMC/509	0+2	--	40	60	100 (2)

IV – Aim of the Course

The course deals with the use of anatomical features of wood in timber identification and classification.

V – Practical

- Study of planes of wood, gross features and physical characteristics of important woods;
- Identification of different types of cells and tissues;
- Anatomical studies of soft and hard woods. Anatomical studies of reaction wood;
- Classification of timber using dichotomous key;
- Modern timber identification techniques.

VI – Suggested Reading

- Agarwal VK and Upadhaya SD. 2006. Agrotechniques of Medicinal and Aromatic Plants. Satish Serial Publishing House.
- Anoop EV. 1971. Timber Identification Manual. Forest Research Institute, Dehradun.
- Dutta JC. 1964. Botany for Degree Students. Oxford University Press, Bombay-Calcutta-Madras.
- Govil JN, Pandey J, Shivakumar BG and Singh VK. 2004. Crop Improvement, Production Technology, Trade Commerce. Lakshman HC and Inchal RF. 2012. Indigenous Medicinal Plants and their Practical Utility.
- Meier E. 2015. Wood Identifying and Using Hundreds of Woods Worldwide. Wood database.
- Porter T. 2004. Wood Identification and Use. Guild of Master Craftsman, UK.
- Purkayastha SK. 1982. Indian Woods: Their Identification Properties and Uses. Controller of Publication.
- Rao R and Juneja KDS. 1971. A Handbook for Field Identification of Fifty Important Timbers of India. Manager of Publications.
- Vashishta PC. 1985. A Text Book of Botany. S. Chand Publishing Company, New Delhi.

SOA/FCMC/510 – CHEMISTRY OF FOREST PRODUCTS & INDUSTRIES

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Chemistry of Forest Products & Industries	SOA/FCMC/510	2+1	60	20	20	100 (3)

IV – Aim of the Course

The course will equip the students regarding forest based industries and their impact on the economy of the country. To support the studies on the role of various products such as pulp, paper, composite wood, furniture match boxes, sports, pencil making, resins and gums, katha, tannins and various types of other non- timber and wood products either produced or processed in these industries. Practicals will make them aware regarding extraction and processing methods of different forest products.

V – Theory

UNIT I

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

UNIT II

Classification and description of different forest based industries – pulp and paper, composite wood, furniture, bamboo, sports goods, pencil making, match box and splint making. Use of lesser known wood species for commercial purposes.

UNIT III

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

UNIT IV

Chemical composition of oleoresin from major pine species. Structural difference among different gums (arabic, ghatti, tragacanth, etc.).

UNIT V

Chemical nature and uses of volatile oils, tannins, katha and cutch and important forest based dyes and pigments.

VI – Practical

- Estimation of cell wall constituents – Hemicelluloses and lignin;
- Extraction of essential oils, resins and tannins;
- Wood pulping. Acetylation of wood;
- Visit to nearby forest based industries.

VII - Suggested Reading

- Bowyer JL, Shmulsky R and Haygreen JG. 2003. Forest Products and Wood Science: An Introduction. 4th Ed. Blackwell Publishing.
- Chung and Deborah DL. 2003. Composite Materials-Functional Materials for Modern Technologies. Springer,Verlag London.
- David AT. 2013. Forest Products: Advanced Technologies and Economic Analyses. Elsevier.
- Eriksson KEL, Blanchette RA and Ander P. 1990. Microbial and Enzymatic Degradation of Wood and Wood Components. Springer,Verlag Berlin Heidelberg.
- Linskens HF and Jackson JF. 1991. Essential Oils and Waxes (Ed.). Springer-Verlag Berlin Heidelberg.
- Panda H. 2005. Hand Book on Specialty Gums, Adhesive, Oils, Rosin And Derivatives, Resins, Oleoresins, Katha, Chemicals with Others Natural Products. Asia Pacific business press. Inc.
- Rojas OJ. 2016. Cellulose Chemistry and Properties: Fibers, Nanocelluloses and Advanced Materials (Ed.). Springer International Publishing.
- Rowell RM. 2013. Hand Book of Wood Chemistry and Wood Composites. CRC press, Taylor and Francis group.
- Shackleton S, Shackleton C and Shanley P. 2011. Non-Timber Forest Products in the Global Context (Ed.). Springer, Verlag Berlin Heidelberg.
- Sharma LC. 2012. Development of Forests and Forest Based Industries. M/s Bishen Singh Mahendra Pal Singh.

SOA/FCMC/513 – WOOD SEASONING AND PRESERVATION

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Wood Seasoning and Preservation	SOA/FCMC/513	2+1	60	20	20	100 (3)

IV – Aim of the Course

To understand the importance of wood seasoning and preservation for utilizing secondary timber for multipurpose use.

V – Theory

UNIT I

Wood water relationship, absorption behaviour and wood drying, Refractory and non refractory behaviour of wood, Wood seasoning, types- air, kiln and special seasoning methods like steaming, chemical, high temperature drying, vacuum drying and water conditioning.

UNIT II

Defects of timber- natural, seasoning defects, defects due to external agencies, machining defects. Effect of defects on utilization.

UNIT III

Detection and diagnosis of discolouration and decay in wood: decaying agencies fungi, insects, borer, etc.

UNIT IV

Wood preservation: preservatives and treatment processes. Advantages and safety concern of wood preservatives, fire retardants. Graveyard test and anti-fungal activity of wood. Bio-preservation.

VI– Practical

- Determination of moisture content and swelling coefficients of different woods;
- Comparative studies on air and kiln dried woods;
- Analysis of decayed wood for physical and chemical parameters;
- Treatment of wood with different types of preservatives. Graveyard test.

VII – Suggested Reading

- FAO. 2007. Wood Preservation Manual. International Book Distributor.
- Hunt GM. 1967. Wood Preservation 3rd Ed. Mc GRAW-HILL Book Company.

- Pandey CN and Jain VK. 1992. Wood Seasoning Technology. FRI, Dehradun.
- Purushotham A, Pande JN and Jadhav. 1959. Wood Preservation In India. Manager of Publications.
- Winn W. 1919. Timbers and their Uses. London George Rotledge & Sons Ltd.

SOA/FCMC/514 – PRODUCTION OF MEDICINAL AND AROMATIC CROPS

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Production of Medicinal and Aromatic Crops	SOA/FCMC/514	1+1	60	20	20	100 (2)

IV – Aim of the Course

To acquaint the students with the plant production techniques.

V – Theory

UNIT I

Modes of reproduction in MAP crops and their relevance in maintaining genetic purity of crops. Concept of quality seed production and maintenance.

UNIT II

Soil fertility, essential nutrient elements- functions, deficiency symptoms, availability and factors affecting their availability. Soil micro-organisms and their role in organic matter decomposition. Importance of pH and C:N ratio in plant nutrition. Concept of bio-fertilizers and their potential for use in medicinal and aromatic crops.

UNIT III

Essentials of nursery production, criteria of site selection, and types of nursery, establishment of a model nursery. Nursery raising of medicinal plants. Tissue culture technique and in-vitro propagation of important MAPs.

UNIT IV

Plant protection measures in medicinal and aromatic crops, Quality parameters of seedlings and nursery stock.

VI – Practical

- Asexual/ vegetative reproduction techniques- cutting, budding, layering, etc.;
- Methods of seed collection and storage techniques;
- In-vitro propagation techniques;
- Determination of pH, organic matter and N,P,K from soil.

VII – Suggested Reading

- Atul CK and Kapur BK. 1982. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu-Tawi.
- Chopra AK. 2007. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books.
- Chopra RN, Nayar SL and Chopra IC. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi.
- EIRI Board. 2007. Handbook of Medicinal and Aromatic Plants: Cultivation, Utilization and Extraction Processes. Engineers India Research Institute, New Delhi.
- Gunther E. 1975. The Essential Oils. Robert, K Krieger Pub. Co, New York.
- Khan IA and Khanum A. 2005. Medicinal and Aromatic Plants of India; Herbal Wealth for Human Health. 1st Ed. Ukaaz Publications.
- Muralia S. 2006. Medicinal and Aromatic Plants 1st Ed. Neha Publishers and Distributors.

SOA/FCMC/591 – MASTER’S SEMINAR

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Master’s Seminar	SOA/FCMC/591	0+1	--	--	100	100 (1)
<ul style="list-style-type: none"> Concerned department will organize in house seminars about pre-discussion of the master thesis topics. Departmental committee will discuss and finalize synopsis of master thesis through ppt. presentation. 						

SOA/FCMC/599A – RESEARCH REVIEW

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Research Review	SOA/FCMC/599A	0+7	--	--	100	100 (7)
<ul style="list-style-type: none"> Mid-term progress will be presented by each student by ppt. presentation. Mater thesis review work will be presented by each student. 						

SEMESTER IV**SOA/FEMC/513 – MEDICINAL AND AROMATIC PLANTS IN HEALTH CARE SYSTEMS**

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Medicinal and Aromatic Plants in Health Care Systems	SOA/FEMC/513	2+0	60	40	No Practical	100 (2)
IV – Aim of the Course						
To acquaint the student with the importance of plants used in modern and AYUSH methods of treatment.						

V – Theory**UNIT I**

Concept of Health Care systems

UNIT II

Brief introduction to Ayurveda, Unani, Sidha, Homeopathy, Allopathy, Naturopathy, Electrohomoeopathy, etc.

UNIT III

Important medicinal plants used in treating various diseases in modern and complementary systems.

UNIT IV

Biological activity of selected medicinal plants. Methods of preparing poultices, decoctions, powders, tinctures, active content rich extracts.

VI – Suggested Reading

- Atul CK and Kapur BK. 1982. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu-Tawi.
- Chopra AK. 2007. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books.
- Chopra RN. Nayar SL and Chopra IC. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi.
- Cunningham A. 2014. Applied Ethnobotany: “People, Wild Plant Use and Conservation”. Taylor & Francis.
- Gunther E. 1975. The Essential Oils. Robert, K Krieger Pub. Co, New York.
- Jain SK. 1968. Medicinal Plants. National book trust, New Delhi. Oxford & IBH, New Delhi.
- Khan IA and Khanum A. 2005. Medicinal and Aromatic Plants of India; Herbal Wealth for Human Health. 1st Ed. Ukaaz

Publications.

- Maheshwari JK. 2000. Ethnobotany and Medicinal Plants of Indian Subcontinent. Scientific Publishers, Jodhpur, India.
- Muralia S. 2006. Medicinal and Aromatic Plants 1st Ed. Neha Publishers and Distributors.

SOA/FEMC/514 – PHARMACOGNOSY OF MEDICINAL AND AROMATIC PLANTS

I – Course Title	II – Course Code	III - Credit Hours	Theory	Internal	Practical	Total
Pharmacognosy of Medicinal and Aromatic Plants	SOA/FEMC/514	1+1	60	20	20	100 (2)

IV – Aim of the Course

To develop understanding about microscopical, macroscopical and chemical methods of drug identification.

V – Theory

UNIT I

History and scope of pharmacognosy, Pharmaceutical products. Classification of natural drugs. Chemical nature of drugs. Pharmacognostic analysis of drug plants based on botanical, chemical and histological features.

UNIT II

Evaluation based on pharmacopoeial standards for both single drugs and compound formulations most commonly used in different systems of medicines.

UNIT III

Pharmacognostic features of *Sarpagandha*, *Jatamansi*, *Ashwagandha*, *Turmeric*, *Punarnava*, *Ephedra*, *Gymnema*, *Senna*, *Amla*, *Gokhru*, *Isabgol*, *Black pepper*, *Banafsha*, *Arjun* or any other commercially species specific to the region.

VI – Practical

- Identification of drugs by morphological characters;
- Physical and chemical tests for evaluation of drugs;
- Gross anatomical studies of *Ginger*, *Ashwagandha*, *Senna*, *Gentiana*, *Kalmegh*, *Sarpagandha*, *Mulhati*, *Aconitum* species or any other important species relevant to the region.

VII – Suggested Reading

- Atul CK and Kapur BK. 1982. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu-Tawi.
- Chopra AK. 2007. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books.
- Chopra RN, Nayar SL and Chopra IC. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi.
- Cunningham A. 2014. Applied Ethnobotany: "People, Wild Plant Use and Conservation". Taylor & Francis.
- Cupp J and Tracy TS. 2003. Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
- Gunther E. 1975. The Essential Oils. Robert, K Krieger Pub. Co, New York.
- Gupta K, Tandon N and Sharma M. 2008. Quality Standards of Indian Medicinal Plants.
- Jain SK. 1968. Medicinal Plants. National book trust, New Delhi. Oxford & IBH, New Delhi.
- Khan IA and Khanum A. 2005. Medicinal and Aromatic Plants of India; Herbal Wealth for Human Health. 1st Ed. Ukaaz Publications.
- Maheshwari JK. 2000. Ethnobotany and Medicinal Plants of Indian Subcontinent. Scientific Publishers, Jodhpur, India.
- Muralia S. 2006. Medicinal and Aromatic Plants. 1st Ed. Neha Publishers and Distributors.

SOA/FE/599B – MASTER’S RESEARCH

I –Course Title	II –Course Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Master’s Research	SOA/FE/599B	0+23	--	--	100 (23)	100 (23)
Evaluation of the master thesis shall be as follows:						
1. Periodical presentation					20 Marks	
2. Viva-Voce					20 Marks	
3. Thesis evaluation					60 Marks	
Evaluation of the thesis shall be done by one external and one internal examiner.						