DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/Sci./University Deptt./NEP/01/2024

It is hereby inform to all concerned that, the syllabi prepared by the Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 05 June 2024 has accepted** the following Syllabi under the Faculty of Science & Technology **as per Norms of National Education Policy – 2020 run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapathi Sambhajinagar** as appended herewith.

Sr.No.	Syllabi of the Department.	Semester
1.	M.Sc. Rural Technology	IIIrd & IVth Semester
2.	M.Sc. Coservation of Biodiversity	IIIrd & IVth Semester

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/NEP/2024/844-52
Date:- 18.06.2024.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **Head of the Department/Director, Department of Gopinathrao Munde National Institute of Rural Development & Research,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] **The Director, University Network & Information Centre, UNIC**, with a request to upload this Circular on University Website.

Copy to :-

1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[M.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
5] The In charge,[E Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF
RURAL DEVELOPMENT AND RESEARCH

Reaccredited with 'A' Grade

FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme in Science

(M.Sc.)

As per National Education Policy - 2020

Revised Course Structure and Curriculum

(Outcome based Credit System)

Subject: Rural Technology

(Effective from 2024-25)

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1. Preamble

Rural development needs an integration of all areas of knowledge. It needs multi-disciplinary approach towards the rural development ideology. The GMNIRD is committed to empower the youth for rural development by catering the needs of the rural development. It will integrate all local institutions, industries, and organizations in the vicinity for the universal coordination of knowledge for overall rural growth & development. Under the Gopinathrao Munde National Institute of Rural Development & Research (GMNIRD) a new syllabus is designed as per New National Education Policy 2020 (NEP – 2020) for Master of Science in Conservation of Biodiversity is to be implemented from the academic year 2023-24 onwards in GMNIRD of Dr. Babasaheb Ambedkar Marathwada University, Chh. Sambhajinagar.

The GMNIRD is established in the Dr. Babasaheb Ambedkar Marathwada University campus as one of the constituent Institute for conducting academic, research, training and extension activities associated with the rural development and management. It is a multidisciplinary Institute covering all disciplines of science, technology, social sciences, agricultural sciences, trade and managerial subjects.

The role of higher education is vital in securing the gainful employment and providing further access to higher education comparable to the best available in the world-class institutions elsewhere. The improvement in the quality of higher education, therefore, deserves to be given tom-most priority to enable the young generation of students to acquire skill, training, and knowledge to enhance their thinking, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes across all undergraduate programs in science, humanities, commerce, and professional streams of higher education. One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome oriented with well-defined aims, objectives, and goals to achieve. The University Grants Commission (UGC) took the initiative of implementing the LOCF in the Colleges and the Universities of the country. Accordingly, the University of Kerala has decided to implement the LOCF in all its departments under the auspices of Internal Quality Assurance Cell (IQAC). A series of teacher training workshops were organised by IQAC and the office of the Credit and Semester System (CSS), and the departments have revised the syllabus accordingly, through workshops and in consultation with academic experts in the field.

2. Vision

1. Improving the quality of life of the rural population.
2. To improve the infrastructure of the rural areas.
3. To reduce unemployment by providing opportunities for employment.
4. To provide clean water, electricity, employment, and proper communication for rural development.
5. To ensure an improvement in the underprivileged populations standard of living.

3. Mission

1. To achieve enhanced crop production for rural areas.
2. To bring about a greater socio-economic equity.
3. To bring about a spatial balance in socio-economic development.
4. To bring about improvement in the ecological environment.
5. To develop bread-based community participation for the rural development.

4. General Objectives of the Course

1. To serve as a national and regional hub of knowledge connectivity for rural development.
2. To support developmental plans and policies for rural development by research, training and demonstration and create functioning packages of social and physical technologies and economic policy strategies.
3. To facilitate the development of techno-managerial cadres needed for the rural development.
4. To create innovative academic programmes. At the same time, evolve HRD package (including training) suitable for the development of the region.
5. To help create special institutional structures and schemes for nurturing the leadership in regional development/ Agripreneur / Coopreneurship with special focus on the most Socio-economically backward and drought regions.

5. Programme Objectives

1. The Programme has been framed to provide an understanding and experience of different aspects of Rural Development.
2. It is to provide a holistic perspective of schemes/programmes of central govt. in general and particular in state government.
3. It is innovative, skill and employment oriented to attract bright students to the discipline of rural development.

6. Learning Objectives

1. The course will cover conservation and biodiversity at both the population and ecosystem level with focus on ecological and evolutionary processes and their interactions.
2. Relevant principles from behavioural ecology, population ecology, genetics and evolution will be related to conservation biology and biodiversity.
3. Both the theoretical foundations of conservation biology and empirical examples will be covered.

7. Programme Specific Objectives (PSOs)

1. Mastery in biodiversity and its conservation strategies.
2. Experience and identify the diversity of plant and animal kingdom, from lower to higher level.
3. Recognize the need to conserve the wealth of Biodiversity.
4. Address environmental issues related to biodiversity.
5. Create social awareness in biodiversity conservation and sustainable utilization of bio-resources.

8. Eligibility

1. Candidates who have passed any bachelor's degree [10+2+3/4] of Science, Engineering, Agriculture, and any other equivalent degree of statutory University recognized equivalent thereto must have obtained minimum aggregate **50** per cent marks for open categories and minimum **45** per cent marks for reserved categories.
2. He/ She should have passed the Entrance Test conducted by the University with the specified criteria.

9. Intake Capacity

Admissions for 30 students are available in the first Semester at the beginning of the academic year.

10. Duration

1. The course shall be a Post-Graduate Full Time Course.
2. The duration of course shall be of Two years with Four Semesters.
3. Maximum Period for Completion of Programme would be four years.

11. Medium of Instruction

The medium of instruction shall be in English.

12. Course Structure (Marking Scheme)

Total Marks for PG Programme will be 2200.

Two-Year Post-graduate Program

Course and Credits Distribution of Two years Master's Degree Program with Entry & Exit option

Faculty of Science and Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year/ 6.0	I	3(4) +2=14	4	4			22	PG Diploma (After 3 years degree)
	II	3(4) +2=14	4		4		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semesters with completion of courses equivalent to 44 credits								
Second Year /6.5	III	3(4) +2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3 (4) = 12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three-year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four year UG degree								

ABBREVIATION:

Major – Comprising Mandatory –is based on specialization

DSE- Discipline Specific Elective

OJT – On-the- Job Training

FP – Field Project Corresponding to the Major (Core) Subject

RP – Research Project Corresponding to the Major (Core) Subject

Internship/Apprenticeship - Corresponding to the Major (Core) Subject

Note-

1. The workload relating to a course is measured in terms of credits hours.
2. A credit is a unit by which the coursework is measured
3. Each course may have –
    a. only lectures-
    b. lecture and tutorial –
    c. lecture and practicum
    d. lecture, tutorial and practice components
4. One credit- one clock hour lecture in a week.
5. Three credits lecture course in a semester means three one-hour lectures per week.
6. In semester of 15 weeks duration = two credit lecture course is equivalent to 30 hours of teaching in a semester.
7. One credit for tutorial means one hour of engagement per week. In a semester 15 weeks duration – a one credit tutorial in a course is equivalent to 15 hours engagement.
8. A one credit course for- practical/lab work/ community enjoyment program/filed work /seminar/internship /project in a semester means two-hour engagement per week.
9. In a semester of 15 weeks duration a two credit practical in course is equivalent to 30 hours.
10. 1 Credits =25 Marks

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13. Course Structure

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: I Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/500-T	Natural Rural Resources	2	-	2	-	14
	MRT/MJ/501-T	Crop Production Technology	2		2	-	
	MRT/MJ/502-T	Irrigation Technology	2	-	2	-	
	MRT/MJ/503-P	Lab-I: Natural Rural Resources		4		2	
	MRT/MJ/504-P	Lab-II: Crop Production Technology		4		2	
	MRT/MJ/505-P	Lab-III: Irrigation Technology	-	4	-	2	
	MRT/MJ/506-P	Skill Based : Indigenous Technical Knowledge System	-	4	-	2	
DSE (Choose any one from pool of courses)	MRT/DSE/507-T	Fundamentals of Biodiversity and Conservation	2		2		04
	MRT/DSE/508-P	Lab-IV: Fundamentals of Biodiversity and Conservation		4		2	
	or	or					
	MRT/DSE/509-T	Watershed Management - I	2		2		
	MRT/DSE/510-P	Lab-IV: Watershed Management - I		4		2	
	or	or					
	MRT/DSE/511-T	Animal Husbandry	2		2		
	MRT/DSE/512-P	Lab-IV: Animal Husbandry		4		2	
RM	MRT/RM/513-T	Research Methodology	4	-	4	-	04
			12	20	12	10	22 Credits

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: II Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/550-T	Commercial Plant Breeding	2		2		14
	MRT/MJ/551-T	Food Processing Technology-I	2		2		
	MRT/MJ/552-T	Drying of Farm Crops	2		2		
	MRT/MJ/553-T	Rural Health Management	2		2		
	MRT/MJ/554-P	Lab-I: Commercial Plant Breeding		4		2	
	MRT/MJ/555-P	Lab-II: Food Processing Technology-I		4		2	
	MRT/MJ/556-P	Lab-III: Drying of Farm Crops		4		2	
DSE (Choose any one from pool of courses)	MRT/DSE/557-T	Green House Technology	2		2		04
	MRT/DSE/558-P	Lab-IV: Green House Technology		4		2	
	or	or					
	MRT/DSE/559-T	Nursery Techniques Management	2		2		
	MRT/DSE/560-P	Lab-IV: Nursery Techniques Management		4		2	
	or	or					
	MRT/DSE/561-T	Climate Change	2		2		
	MRT/DSE/562-P	Lab-IV: Climate Change		4		2	
OJT/FP	MRT/OJT/FP/563-P	On Job Training/Field Project	-	8	-	4	04
			10	24	10	12	22 Credits

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: III Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/600-T	Watershed Management –II	2		2		14
	MRT/MJ/601-T	Food Processing Technology-II	2		2		
	MRT/MJ/602-T	Rural Tourism	2		2		
	MRT/MJ/603-T	ICT in Rural Technology	2		2		
	MRT/MJ/604-P	Lab-I: Watershed Management – II		4		2	
	MRT/MJ/605-P	Lab-II: Food Processing Technology-II		4		2	
	MRT/MJ/606-P	Lab-III: Rural Tourism		4		2	
DSE (Choose any one from pool of courses)	MRT/DSE/607-T	Organic Farming	2		2		04
	MRT/DSE/608-P	Lab-IV: Organic Farming		4		2	
	or	or					
	MRT/DSE/609-T	Medicinal and Aromatic Plants	2		2		
	MRT/DSE/610-P	Lab-IV: Medicinal and Aromatic Plants		4		2	
	or	or					
	MRT/DSE/611-T	Environment & Disaster Management	2		2		
	MRT/DSE/612-P	Lab-IV: Environment & Disaster Management		4		2	
RP-1	MRT/RP-I/613-P	Research Project-I		8		4	04
			10	24	10	12	22 Credits

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year **Semester: IV** **Subject: Rural Technology**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/650-T	Agricultural Biotechnology	2		2		12
	MRT/MJ/651-T	Biomass Management & Utilization	2		2		
	MRT/MJ/652-T	Apiculture	2		2		
	MRT/MJ/653-P	Lab-I: Agricultural Biotechnology		4		2	
	MRT/MJ/654-P	Lab-II: Biomass Management & Utilization		4		2	
	MRT/MJ/655-P	Lab-III: Apiculture		4		2	
DSE (Choose any one from pool of courses)	MRT/DSE/656-T	Farm Machine and Power	2		2		04
	MRT/DSE/657-P	Lab-IV: Farm Machine and Power		4		2	
	or	or					
	MRT/DSE/658-T	Power System for Renewable Energy Sources	2		2		
	MRT/DSE/659-P	Lab-IV: Power System for Renewable Energy Sources		4		2	
	or	or					
	MRT/DSE/660-T	Mushroom Cultivation Techniques	2		2		
	MRT/DSE/661-P	Lab-IV: Mushroom Cultivation Techniques		4		2	
RP-2	MRT/RP-II/662-P	Research Project-II		12		6	06
			08	28	08	14	22 Credits

14. Curriculum For Semester – I

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: I Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/500-T	Natural Rural Resources	2	-	2	-	14
	MRT/MJ/501-T	Crop Production Technology	2		2	-	
	MRT/MJ/502-T	Irrigation Technology	2	-	2	-	
	MRT/MJ/503-P	Lab-I: Natural Rural Resources		4		2	
	MRT/MJ/504-P	Lab-II: Crop Production Technology		4		2	
	MRT/MJ/505-P	Lab-III: Irrigation Technology	-	4	-	2	
	MRT/MJ/506-P	Advance technique: Indigenous Technical Knowledge System	-	4	-	2	
DSE (Choose any one from pool of courses)	MRT/DSE/507-T	Fundamentals of Biodiversity and Conservation	2		2		04
	MRT/DSE/508-P	Lab-IV: Fundamentals of Biodiversity and Conservation		4		2	
	or	**or**					
	MRT/DSE/509-T	Watershed Management - I	2		2		
	MRT/DSE/510-P	Lab-IV: Watershed Management - I		4		2	
	or	**or**					
	MRT/DSE/511-T	Animal Husbandry	2		2		
	MRT/DSE/512-P	Lab-IV: Animal Husbandry		4		2	
RM	MRT/RM/513-T	Research Methodology	4	-	4	-	04
			12	20	12	10	22 Credits

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- I)

Course Code No.: MRT/MJ/500-T	No. of Credits: 02	Hours: 30
Course Title	**Natural Rural Resources**	

Learning Objectives:

1. To understand the nature and characteristics of rural resource and its importance in Rural Development.
2. To understand various resources available in rural India such as land, water and human and other Resources.
3. To get acquainted with Government initiatives and participation related to rural resources.

Unit	Course Content	Periods
I	**Nature and Characteristics of Rural Resources** Definition and meaning of Resources, Types of Rural Resources, Natural and Man-made, Characteristics of Resources, Importance of different resources in Rural Development.	06
II	**Land Resources** Classification of land based on utility, Soils – Structure and importance, Properties of Soil- Physical and Chemical, Soil Conservation- methods and importance, Rock and ores – Minor mineral produce in rural areas of Konkan, Land degradation in rural areas – causes and remedies.	06
III	**Water resource** Factors controlling availability of water in rural areas- Seasonality of rainfall, rock type, vegetative cover, Source of water and their characteristics – Sub-Surface- Deep and Shallow and Surface, Water conservation and management- Watershed development, rain water harvesting, advanced irrigation, Ground water recharge, Problems and issues in rural water scenario- Contamination, Distribution, Priority of Use.	06
IV	**Living Resources** Vegetation – Types of uses, Importance as resource- Timber, fuel, construction, agricultural, plantation, raw material, Forest rights and Joint Forest management, Wide life- Diversity of life, it's role in ecology, resources potential, Nature of conflict between wide life and Farmers in Konkan. **Human Resources** Quantitative aspects of rural human resource – Gender & Age wide classification, Density, Issue in rural human resources- Scarcity, lack of skill, attitude and social status.	06
V	Government initiatives and participation of various Stake holders for development and Protection of Rural resources.	06

Learning Outcomes

1. The students will understand various natural resources and their importance in rural development.
2. The students will get exposure to various challenges and problems with regard to availability and use of natural resources.
3. Students will demonstrate effective application of solve problems of rural resources and perform relevant activities

Suggested Readings

1. Rural Development: Principles, Policies and Management, Katar Singh, Sage Publications India Pvt. Ltd., 2009.
2. Development of Land Resources – E-book on Activities Department of Land Resources, Ministry of Rural Development, Government of India, Dec. 2014,
3. http://dolr.nic.in/downloads/PDFs/DoLR%20Activities.pdf

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- II)

Course Code No.: MRT/M.I/501-T	No. of Credits: 02	Hours: 30
Course Title:	**Crop Production Technology**	

Learning Objectives

1. To prepares students to operate enterprises related to crop production
2. To make students aware of technology in producing cereal grain, fibre, forage, oilseed, tree fruits and nuts, etc.
3. To get acquainted with crop cultivation practices, plant diseases, pest management, harvesting and marketing.

Unit	Course Content	Periods
I	Classification of crops; Effect of different weather parameters on crop growth and development; Principles of tillage; Soil-water-plant relationship , crop rotation, cropping systems, relay cropping and mixed cropping; Crop production technology for **major cereal crops** viz., paddy, wheat, maize, pearl millet, sorghum, etc.; Major varieties, sowing time, method of sowing, spacing, inter culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.;	06
II	Crop production technology for **major oilseed crops** viz., groundnut, sesame, rapeseed, mustard, castor, etc.: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Crop production technology **for major pulse crops** viz., pigeon pea, cowpea, gram, green gram, black gram, etc.: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.;	06
III	Crop production technology for **major spices and cash crops** viz., cumin, coriander, funnel, ginger, garlic, sugarcane, etc.: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; **forage crops**-sorghum, cowpea, cluster bean and napier. Forage crops-berseem, lucerne and oat. **medicinal and aromatic crops**-mentha, lemon grass and citronella,	06
IV	**Horticulture:** Scope of horticultural crops. Soil and climatic requirements for fruits and vegetables, nursery raising and management; Crop production technology **for major fruit crops** viz., mango, banana, sapota, aonla, pomegranate, guava, etc.: Major varieties, time of transplanting, spacing, inter-culturing, fertilizer and water requirement, time and method of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.;	06
V	Crop production technology for **major vegetable crops** viz., potato, onion, tomato, chilli and other green and leafy vegetables: Major varieties, sowing time, method of sowing, spacing, inter culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc	06

Learning Outcomes:

1. Students will demonstrate knowledge of scientific principles related to agriculture.
2. Students will demonstrate knowledge of agricultural industries including structure, production practices, and management principles.
3. Students will demonstrate effective application of agricultural knowledge and resources to solve problems and perform relevant activities.

Suggested Reading

1. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios, New Delhi.
2. Yellamanda Reddy and G.H. Shankar Reddy. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. S.S. Singh., Principles and Practices of Agronomy. 1985. Kalyani Publishers, Ludhiana

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL

DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- III)

Course Code No.: MRT/MJ/502-T	No. of Credits: 02	Hours: 30
Course Title:	**Irrigation Technology**	

Learning Objectives

1. To familiarize students with concepts and fundamentals of agricultural production system
2. To enable students, thorough understand soil-water plant relationships
3. To give students comprehensive knowledge of crop water requirement and its estimations

Unit	Course Content	Periods
I	Measurement of Land, i.e. size, shape, Calculation formulae, Land shaping, Levelling, grading, Measurement of slope & its methods.	06
II	Measurement of water storage, flows and instruments used, Application methods for different types of crops, Furrows, Basin, Raised beds, Borders.	06
III	Different crops; Horticulture, sericulture, cereals, Pules, cash crops, their stages, crop water requirements, formulae, Evapotranspiration of crops.	06
IV	Pressurized irrigation systems, types, Sprinkler irrigation – parts, functioning, Layouts, Evaluation Maintenance & Repairing, Government facilities.	06
V	Drip irrigation – Parts, layout, functioning, Evaluation, Government. Facilities, underground systems & miscellaneous.	06

Learning Outcomes:

1. Acquire knowledge of irrigation water
2. Use of irrigation water in farm lands
3. Understand different irrigation methods

Suggested Readings

1. "Drainage Engineering" by J. N. Luthin, 1st edition, 2021
2. "Irrigation -Theory and Practice" by A.M. Michael, 2nd edition, 1978
3. "Irrigation Engineering" by Gurcharan Singh, 2nd edition, 2010
4. "Irrigation And Drainage" by D. Lenka, 2013
5. "Irrigation and Drainage Engineering" by Peter Waller and MulunehYitayew Volume 1st 2002

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- IV)

Course Code No.: MRT/MJ/503-P	No. of Credits: 02	Hours: 30
Course Title	**Lab-I - Natural Rural Resources**	

Learning Objectives:

1. To understand the nature and characteristics of rural resource and its importance in Rural Development.
2. To understand various resources available in rural India such as land, water and human and other Resources.
3. To get acquainted with Government initiatives and participation related to rural resources.

Unit	Course Content	Periods
I	1) To Study of Nature and Rural Resources 2) To Study of Characteristics of rural resources 3) To Study of Natural and Man- Made Resources for rural development area	06
II	4) To Study of Land Resources and its Importance 5) To Study of soil Properties 6) To Study of different types of rocks available in India (Maharashtra)	06
III	7) To Study of water resources 8) To Study of water erosion and water conservation or its management for rural development area 9) To Study of Irrigation method, issues in rural area and its remedies	06
IV	10) To Study of living resources 11) To Study of forest and its management for precipitation 12) To Study of ecology and role of ecology between wide life and farmers.	06
V	13) To Study of human resources 14) To Study of issue in rural human resources 15) To Study remedies on human resources	06

Learning Outcomes

1. The students will understand various natural resources and their importance in rural development.
2. The students will get exposure to various challenges and problems with regard to availability and use of natural resources.
3. Students will demonstrate effective application of solve problems of rural resources and perform relevant activities

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- V)

Course Code No.: MRT/MJ/504-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-II - Crop Production Technology**	

Learning Objectives

1. To prepares students to operate enterprises related to crop production.
2. To make students aware of technology in producing cereal grain, fibre, forage, oilseed, tree fruits and nuts, etc.
3. To get acquainted with crop cultivation practices, plant diseases, pest management, harvesting and marketing.

Unit	Course Content	Periods
I	1) To Study of crops and its Classification 2) To Study of Major Crops. 3) To Study of climate change effect on crop growth	06
II	4) To Study of crop production technology for major oilseed crops 5) To Study of crop production technology for major pulse crops 6) To Study of comparison between oilseed and pulse crops benefits at rural area.	06
III	7) To Study of crop production technology for major spices and cash crops 8) To Study of crop production technology for major Forage crops 9) To Study of crop production technology for major medicinal and aromatic crops	06
IV	10) To Study of Horticulture and its Scope horticulture crops 11) To Study of crop production technology for major Fruit Crops 12) To Study of comparison between horticulture crops of drought area and Irrigated area	06
V	13) To Study of crop production technology for major Vegetable crops 14) To Study of pre planning of vegetable crops in transplanting 15) To Study of issues in vegetable crops and its solution.	06

Learning Outcomes:

1. Students will demonstrate knowledge of scientific principles related to agriculture.
2. Students will demonstrate knowledge of agricultural industries including structure, production practices, and management principles.
3. Students will demonstrate effective application of agricultural knowledge and resources to solve problems and perform relevant activities.

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(MANDATORY SUBJECT- VI)

Course Code No.: MRT/MJ/505-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-III - Irrigation Technology**	

Learning Objectives

1. To familiarize students with concepts and fundamentals of agricultural production system
2. To enable students, thorough understand soil-water plant relationships
3. To give students comprehensive knowledge of crop water requirement and its estimations

Unit	Course Content	Periods
I	1) To study of measurement of Land 2) To study of surveying and levelling. 3) To study of calculation methods to measurement of different types of land.	06
II	4) To study of Water storage measurement. 5) To study of water application methods of crops. 6) To study of comparison between method of water application.	06
III	7) To study of water requirements of different crops. 8) To study of formulate on calculating of water requirement of crops. 9) To study of transpiration and evapotranspiration of crops.	06
IV	10) To study of pressurized irrigation system. 11) To study of sprinkler irrigation system. 12) To study of layout of sprinkler irrigation system.	06
V	13) To study of drip irrigation system. 14) To study of layout of drip irrigation system. 15) To study of comparison between inline and outline drip irrigation system.	06

Learning Outcomes:

1. Acquire knowledge of irrigation water
2. Use of irrigation water in farm lands
3. Understand different irrigation methods

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(MANDATORY SUBJECT- VII)

Course Code No.: MRT/MJ/506-P	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Advance technique: Indigenous Technical Knowledge System**	

Learning Objectives

1. To facilitate the students with the concepts of Indian traditional knowledge
2. To make them understand the Importance of roots of knowledge system.
3. To illustrate the significance of Traditional and Modern knowledge system

Unit	Course Content	Periods
I	1) To Study of the concept of traditional, indigenous, western and formal knowledge 2) To Study of characteristics and scope of traditional, indigenous, western and formal knowledge 3) To Study of historical impact of social change on indigenous, western and formal knowledge	06
II	4) To Study of the need and importance of protecting traditional knowledge. 5) To Study of the value of traditional knowledge in the global economy 6) To Study of role of government to harness of traditional knowledge.	06
III	7) To Study of various enactments related to the protection of traditional knowledge 8) To Study of the legal frame work traditional knowledge. 9) To Study of The Recognition of Forest Rights, PPVFR Act, Biological Diversity Act 2002/2004, Geographical indications act 2003, the protection of traditional knowledge bill, 2016.	06
IV	10) To Study of concepts of Intellectual property Rights to protection of the traditional knowledge 11) To Study of Strategies to increase protection of traditional knowledge 12) To Study of the global legal FORA for increasing protection of Indian traditional knowledge	06

V	13) To Study of the traditional knowledge in different sectors. 14) To Study of traditional knowledge importance in conservation and sustainable development of environment 15) To Study of Food security of the country and protection of traditional knowledge	06

Learning Outcomes:

1. Students will demonstrate knowledge of ITKS related to agriculture.
2. Students will demonstrate knowledge of ITKS including structure, production practices, and management principles.
3. Students will demonstrate effective application of ITKS and resources to solve problems and perform relevant activities.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- I)

Course Code: No: MRT/DSE/507-T	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Fundamentals of Biodiversity and Conservation**	

Learning Objectives

1. To extend the importance of interactions among the species
2. To demonstrate the importance of maintains, conservation of ecosystem
3. To illustrate the significance of conservation of agricultural biodiversity

Unit	Course Content	Periods
I	**Biodiversity** Concept, definition and type of biodiversity, biodiversity at global, country and local level, evolution of biodiversity, factor promoting high diversity, Endemism and hotspots of biodiversity, India as mega biodiversity nation, wealth of Indian hot spots, monitoring and measures of biodiversity.	06
II	**Values of Biodiversity** 2.1. Utilitarian value and their categories, direct use value; indirect/ Non-consumptive use value. 2.2.Ecological Economics; Monetizing the value of Biodiversity; Intrinsic Value; Ethical and aesthetic values, Anthropocentrism, Biocentrism, Ecocentrism and Religions; Intellectual Value; 2.3.Biodiversity and sustainable development	06
III	**Threats to Biodiversity** 3.1. Habitat destruction, fragmentation, transformation, degradation and Loss: Causes, Patterns and consequences on the Biodiversity of Major Land and Aquatic Systems **3.2. Impact of human development on biodiversity** **Invasive species:** their introduction pathways, biological impacts of invasive species on terrestrial and aquatic systems **3.3. Effect of pollution on biodiversity**: Impacts of pesticide pollution, water pollution and air pollution on biodiversity **Overexploitation:** Impacts of exploitation on target and non-target terrestrial and aquatic species and ecosystems **Extinction:** Types of extinctions, processes responsible for species extinction, current and future extinction rates, IUCN threatened categories, sixth extinction/biological crisis	06
IV	**Conservation Planning and Climate Change** The Bioclimatic Envelope Model for individual species; Climate Change -Integrated strategies for Conservation; Predictions on future responses of ongoing Climate Change on	06

	Biodiversity, Potential Adaptation Options and their consequences on Ecosystems and Biodiversity, REDD+, Synergies between Sustainable Use of Biodiversity and Climate Change	
V	**Conservation of Agricultural Biodiversity** 5.1. Conserving species of Economic significance 5.2. Significance of gene banks and germ plasm conservation 5.3. Use of wild species for producing improved hybrid varieties 5.4. Seed Banks & Artificial seeds in conservation 5.5. Conservation of Live Stock species /varieties 5.6. Alternate species for future food securities (examples); Job's tear plant (Coixlacrymajobi) Indian wild buffalo (Bubalusarnee) Mithun (Bos frontalis). Hybrids between wild and domestic species (e.g. Mithun) Conservation of economically important aquatic species	06

Learning Outcomes

1. To understand different type of ecosystem services and provide examples of ultimate and proximate threats to biodiversity and ecosystem integrity.
2. To understand that ecological processes are essential for maintaining biodiversity and ecosystem integrity.
3. To understand the habitat loss and fragmentation and their impacts on biodiversity and ecosystem integrity

Suggested Readings:

1. Groom, M. J., Meffe, G. R. and C. R. Carroll. Principles of Conservation Biology. Sinauer Associates, Inc., USA. 2006
2. Krishnamurthy, K. V. Textbook of Biodiversity, Science Publication. 2003
3. Primack, R. Essentials of Conservation Biology.Sinauer Associates, Inc., USA. 2006
4. Hambler, C. Conservation. Cambridge University Press. 2004
5. Van Dyke, F.Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer. 2008

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- II)

Course Code No.: MRT/DSE/508-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Fundamentals of Biodiversity and Conservation**	

Learning Objectives

1. To extend the importance of interactions among the species
2. To demonstrate the importance of maintains, conservation of ecosystem
3. To illustrate the significance of conservation of agricultural biodiversity

Unit	Course Content	Periods
I	1) To Study of Biodiversity and its types 2) To Study of ultimate and proximate threats to biodiversity 3) To Study of evolution of biodiversity and wealth of Indian hot spots	06
II	4) To Study of values of biodiversity 5) To Study of Ecological Economics 6) To Study of biodiversity and sustainable development	06
III	7) To Study of threats to biodiversity 8) To Study of impact of human development on biodiversity 9) To Study of effect of pollution on biodiversity	06
IV	10) To Study of conservation planning and climate change 11) To Study of integrated strategies for conservation 12) To Study of REDD+, Synergies between sustainable use of biodiversity and climate change	06
V	13) To Study of conservation of agriculture biodiversity 14) To Study of significance of seed bank and artificial seeds in conservation 15) To Study of conservation of livestock species/verities	06

Learning Outcomes

1. To understand different type of ecosystem services and provide examples of ultimate and proximate threats to biodiversity and ecosystem integrity.
2. To understand that ecological processes are essential for maintaining biodiversity and ecosystem integrity.
3. To understand the habitat loss and fragmentation and their impacts on biodiversity and ecosystem integrity

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- III)

Course Code No.: MRT/DSE/509-T	No. of Credits: 02	Hours: 30
Course Title:	**Watershed Management – I**	

Learning Objectives

1. To understand different watershed behaviour
2. To be able to interpret runoff data and quantify erosion by using various modelling Methods.
3. To understand land use classification and impact of land use changes on hydrological cycle Parameters

Unit	Course Content	Periods
I	**Introduction to Basic Concept** Concept of watershed, History & present status of development, different stake holders & their importance, community participation, Gram Sabha, gram samiti, policies & decision making, role of govt in watershed Management, NGOS in watershed Management, Private Sector participation, Self-help groups case studies. (Theoretical & analytical)	06
II	**Natural Resources** Units of Measurement of water & land, Needs & availability in watershed, size & shape of watershed, Norms of Government, Qualities & standards for human being & agriculture, (Theoretical & analytical)	06
III	**Soil & Water Conservation –** Erosion & their types, soil & water conservation, treatments, drainage line treatments, gully plugs, brushwood dams, Vanaraibandhara, loose boulder dams, gabianbandhara, underground bandhara earthen nalla bund, cement nalla bund, Kadia pattern, shirpur pattern, (Theoretical & analytical)	06
IV	**Treatment on land –** Tree plantation, grasses, contour trenches, compartment bunding, land levelling, grading, smoothening, farm ponds, recharging of wells bores, Mapping, Scales, Symbols, drawings. Land capability & land use planning. (Theoretical & analytical)	06
V	**Climates** Its factors, units, meteorological lab, rainfall, rainfall intensity, rainfall patterns rain gauges, evaporation, Evaporimeter, wind, anemometer, humidity, dry & wet bulb thermometer, sunshine, sunshine recorder, water budgeting. Steps in watershed management. (Theoretical & analytical)	06

Learning Outcomes

1. Suggest technical measures for soil erosion control both due to water and wind
2. Assess the current status of the watershed at field, by taking up accurate investigation measures and conduct survey
3. Suggest drought control measures, water conservation structures, including design

Suggested Readings

1. The Rain water Technology Handbook: Rain harvesting In Building, Klaus Koenig
2. Soil & Water Conservation & Watershed Management Hardcover – 2012, Singh PK Mahnot
3. Watershed Management (English, Murthy J V S), New age International Publishers Ltd.-New Delhi. 2nd edition., 2017
4. "Hydrology and Water Resources Engineering" by S K Garg Volume 1st 2015
5. "Engineering Hydrology" by K Subramanya, 4th edition, 2017
6. Soil & Water Conservation Engineering by R. Suresh. 2005.

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(ELECTIVE SUBJECT- IV)

Course Code No.: MRT/DSE/510-P	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Lab-IV - Watershed Management – I**	

Learning Objectives

1. To understand different watershed behaviour
2. To be able to interpret runoff data and quantify erosion by using various modelling Methods
3. To understand land use classification and impact of land use changes on hydrological cycle Parameters

Unit	**Course Content**	**Periods**
I	1) To Study of basic concept of watershed management 2) To Study of history and status of development of watershed management 3) To Study of role of government private sector participation, SHG's and NGOS in watershed management	06
II	4) To Study of Units of Measurement of water & land 5) To Study of Needs & availability in watershed 6) To Study of size & shape of watershed	06
III	7) To Study of soil and water erosion 8) To Study of soil and water conservation 9) To Study of different measures for soil and water conservation	06
IV	10) To Study of trenches and bunding 11) To Study of farm pond and recharging of wells bores 12) To Study of land capability and land use planning	06
V	13) To Study of climates related to metrological lab 14) To Study of evaporation and evapotranspiration 15) To Study of instruments of metrological Lab	06

Learning Outcomes

1. Suggest technical measures for soil erosion control both due to water and wind
2. Assess the current status of the watershed at field, by taking up accurate investigation measures and conduct survey
3. Suggest drought control measures, water conservation structures, including design

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(ELECTIVE SUBJECT- V)

Course Code No.: MRT/DSE/511-T	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Animal Husbandry**	

Learning Objective :

1. To increase awareness amongst the rural masses regarding improved Animal Husbandry practices.
2. To provide gainful self-employment to the weaker sections of the society in livestock sector.
3. To create and maintain a "Disease Free Status" of major production areas so as to boost export of livestock products

Unit	**Course Content**	**Periods**
I	Place of livestock in the national economy, different livestock development programmers of govt. of India. Important exotic and Indian breeds of cattle, buffalo, sheep & goat.	06
II	Measures and factors affecting fertility in livestock, reproduction behaviour like estrus, parturition, etc Milk secretion, milking of animals and factors affection milk yield and composition.	06
III	Selection and breeding of livestock for higher milk and meat production. Feeding and management of calves, growing heifers and milk animals & other classes of animal.	06
IV	Different type of animal housing principles space requirement for different species of livestock. Disease control measures sanitation and care breeding and production records.	06
V	Introduction of poultry house, Buffalo, sheep, goat. Prevention of diseases, Preservation and marketing of eggs it's economics and keeping quality cost of production of milk, economical units of cattle, buffalo, sheep & goat.	06

Learning Outcomes:

1. To determine and know the standards of care for animals in a colony setting.
2. To use safe handling techniques and aids for moving and restraining healthy cats and dogs.
3. To observe & document typical behaviours, attitudes and health indicators of cats and dogs.

Suggested Readings:

1. A Textbook of Animal Husbandry by G C Banerjee. 8th edition 2019
2. Advanced Animal Nutrition by D. V. Reddy 1st edition 2020
3. Agricultural Economics by S. Subba Reddy 2nd edition 2019
4. Animal Husbandry by Gyan Deep Singh, Anmol Publishers, 2008
5. Animal Physiology by K. A. Goyal, Rastogi Publishing, 2003
6. Animal Physiology by Kavita Juneja, Anmol Publishers 2002
7. Biotech's Dictionary of Animal Husbandry by L.L. Somani Daya Publishing, Volume 2nd
8. Biotechnology Expanding Horizons by B D Singh, Kalyani Publishers, 2020

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- VI)

Course Code : MRT/DSE/512-P	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Lab-IV - Animal Husbandry**	

Learning Objective :

1. To increase awareness amongst the rural masses regarding improved Animal Husbandry practices
2. To provide gainful self-employment to the weaker sections of the society in livestock sector
3. To create and maintain a "Disease Free Status" of major production areas so as to boost export of livestock products

Unit	**Course Content**	**Periods**
I	1) To Study of Place of livestock in the national economy 2) To Study of different livestock development programmers of govt. of India. 3) To Study of Important exotic and Indian breeds of cattle, buffalo, sheep & goat.	06
II	4) To Study of Measures and factors affecting fertility in livestock 5) To Study of reproductive system of livestock's 6) To Study of milk method of livestock's	06
III	7) To Study of Selection and breeding of livestock for higher milk and meat production. 8) To Study of Feeding and management of calves 9) To Study of growing heifers and milk animals & other classes of animal.	06
IV	10) To Study of animal housing principles space requirement for different species of livestock. 11) To Study of different disease of livestock's 12) To Study of disease control measures sanitation and care breeding	06
V	13) To Study of poultry Farm 14) To Study of Buffalo Farm 15) To Study of sheep and goat farm	06

Learning Outcomes:

1. To determine and know the standards of care for animals in a colony setting.
2. To use safe handling techniques and aids for moving and restraining healthy cats and dogs.
3. To observe & document typical behaviours, attitudes and health indicators of cats and dogs.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(RESARCH METHODOLOGY)

Course Code No.: MRT/RM/513-T	No. of Credits: 04	Hours: 60
Course Title:	**Research Methodology**	

Learning Objectives

1. Student will know the different research approaches, scientific methods, criteria for good research and innovation.
2. Student will get knowledge of problems encountered while working on research plan, Field and laboratory research problems.
3. Students can design the research project with the help of review of produced results, techniques of interpretation, published literature and proper layout of research report

Unit	Course Content	Periods
I	Definition of research, Objectives of research, Research approaches, Significance of research, Research and scientific methods, Innovation and research, Research process, Criteria of good research, Defining the research problem, Technique involved in defining a problem, Research designs, Developing a perspective research plan.	12
II	Data collection-by survey method and by experimentation. Types of data, Data presentation methods, Data analysis, process of data analysis, Sampling: Populations and samples, Probability and non-probability samples. Simple Random and Stratified sampling.	12
III	Data collection by questioner method, by field visit and by direct observations, Measurements and experimentation, Measures for maintaining accuracy in data.	12
IV	Statistical analysis of data, Determination of mean, Median, mode, Dispersion, standard deviation, Stander errors of data, Correlation study, Significance of studies and Regression analysis of data.	12
V	Interpretation of data, Interpretation of produced results, Techniques of interpretation, Conclusion of research work, Reviewing of produced results/ output/data with the help of published literature, Scientific output as scientific principle or literature, Report writing, Steps in writing report, Layout of research report , Types of reports, review article writing.	12

Learning Outcomes

1. Explain the different research approaches, scientific methods, criteria for good researches.
2. Design the research project with the help of review of produced research, techniques of interpretation, published literature and proper layout of research.
3. Acquire knowledge of data collection, presentation of data, data analysis and interpretations.

Suggested Readings

1. Research Methodology-Methods and Techniques, By Kothari C.R. (2011); New Age International Publisher, New Delhi.
2. Research methodology-Text and cases with SPSS applications" by Gupta S.L. and Hitesh Gupta (2011); International book house Pvt. Ltd, New Delhi.
3. "Statistical Methods" by S. P. Gupta, Publisher S. Chand and Sons.
4. "Fundamentals of Research methodology and statistics" by Yogesh Kumar Singh, New Age International Publication, New Delhi.
5. "How SAGE has shaped Research methods A 40 years history" by John W Cresewell, University of Nebraska. Lincoln.
6. "The Essence of Research Methodology, by Jan Jonker & Bartjan Pennink, Springer.

15.Curriculum for Semester – II

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: II Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/550-T	Commercial Plant Breeding	2		2		14
	MRT/MJ/551-T	Food Processing Technology-I	2		2		
	MRT/MJ/552-T	Drying of Farm Crops	2		2		
	MRT/MJ/553-T	Rural Health Management	2		2		
	MRT/MJ/554-P	Lab-I: Commercial Plant Breeding		4		2	
	MRT/MJ/555-P	Lab-II: Food Processing Technology-I		4		2	
	MRT/MJ/556-P	Lab-III: Drying of Farm Crops		4		2	
DSE (Choose any one from pool of courses)	MRT/DSE/557-T	Green House Technology	2		2		04
	MRT/DSE/558-P	Lab-IV: Green House Technology		4		2	
	or	**or**					
	MRT/DSE/559-T	Nursery Techniques Management	2		2		
	MRT/DSE/560-P	Lab-IV: Nursery Techniques Management		4		2	
	or	**or**					
	MRT/DSE/561-T	Climate Change	2		2		
	MRT/DSE/562-P	Lab-IV: Climate Change		4		2	
OJT/FP	MRT/OJT/FP/563-P	On Job Training/Field Project	-	4	-	4	04
			10	20	10	12	22 Credits

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(MANDATORY SUBJECT- I)

Course Code No.: MRT/MJ/550-T	No. of Credits: 02	Hours: 30
Course Title	**Commercial Plant Breeding**	

Learning Objectives:

1. To understand the Plant Breeding and its importance in Rural Development.
2. To understand the various commercial plant breeding methods.
3. To make students aware Techniques of Seed Production.

Unit	Course Content	Periods
I	**Plant Reproduction** Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross-pollinated crops (A/B/R and two-line system) for the development of hybrids and seed production.	06
II	**Genetic Purity Test** Genetic purity test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc.	06
III	**Quality Seed Production** Quality Seed production of vegetable crops under an open and protected environment. Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools.	06
IV	**IPR Issues In Commercial Plant Breeding** DUS testing and registration of varieties under PPV&FR Act. Variety testing, release and notification systems in India.	06
V	**Techniques Of Seed Production** Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.	06

Learning Outcomes

1. The students will understand the Plant Breeding and its importance in Rural Development.
2. The students will get exposure to various challenges and problems with regard to availability and use of plant breeding.
3. The Students will demonstrate techniques of seed production perform relevant activities.

Suggested Readings:

1. Hybrid Seed Production in Field Crops: Principles and Practices by N. C. Singhal, 2003, a. Kalyani publication, Delhi.
2. Principles of Seed Technology by P.K. Agrawal, 2002, Oxford.
3. Seed Production of Vegetables. By Prabhakar Singh and B. S. Asati.
4. Seed Technology, R. L. Agarwal 1996, Oxford.
5. Plant Breeding; Principles and Methods by B.D. Singh, 2006, Kalyani publication, Delhi
6. Genetics by P. K. Gupta, 2002 Rastogi publication.
7. Seed Technology by Dhirendra Khare and Mohan S. B. Bhale, 2005
8. Principles and practices of plant breeding by Sharma J. R.1984, Tata Mc Graw –Hill.
9. Practical plant breeding by S. K. Gupta 2004, Agribios publication
10. Fundamentals of Plant Breeding & hybrid seed production, by R. L. Agarwal, 1996, Oxford.

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DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- II)

Course Code No.: MRT/MJ/551-T	No. of Credits: 02	Hours: 30
Course Title:	**Food Processing Technology-I**	

Learning Objectives

1. To prepares students to operate food processing related to some fruit
2. To make students aware of food technology in producing cereal grain, fibre, forage, oilseed, fruits and etc.
3. To learn and understand the basic principles and various methods of food preservation.

Unit	Course Content	Periods
I	**Food and Nutrition** Definition of nutrient, nutrition, food, factors affecting human nutrition, functions of food, Classification of food, food groups, food guide pyramid, nutrient wheel definitions, functions, deficiency symptoms and excessive consumption consequences of micronutrients, water, dietary fibre	06
II	**Food Processing Technologies** Concept – steps and Principles - methods of preservation – important commercial methods like - Canning, preparation of Jam, Jelly, Pickles, Squash, Marmalade, etc.	06
III	**Post-harvest Technology** Role of agro processing in rural development- Scope and importance, Post-harvest Technology – Concept- Importance with reference to agricultural products – Present scenario with reference to World, India, Maharashtra and Marathwada– Scope - extent of Post-harvest losses–causes of Post-harvest losses –salient features of Post-harvest Management.	06
IV	**Post-harvest technology of major crops** Post-harvest technology and product diversification aspect of important crops like Sugarcane-Jaggery production, utilization of molasses, Cereals –Rice; Fruits–Mango, banana, sapota, guava, Lemon; Spices–Ginger, Pepper, Turmeric; Plantation crops - Coconut, Commercial Flowers, etc.	06
V	**Entrepreneurship Development in Food processing Industries** Scope of self – employability – Present scenario - licensing and FSSAI registration aspects - list of machineries used in processing Industry - marketing strategies.	06

Learning Outcomes:

1. Students will demonstrate knowledge of agricultural food industries including structure, production practices, and management principles.
2. Students will demonstrate effective application of food technology knowledge and resources to solve problems and perform relevant activities.
3. The students will get exposure to different technologies of food processing and will have hands on experience of preparation of various processed products.

Suggested Reading

1. Handbooks of vegetable Science and Technology: Production, Composition, Storage and Processing by D. K. Salunkhe, S.S. Kadam, 1st edition, 1995.
2. Post-harvest Technology by S. Krishnaprabhu, 2020
3. Post-harvest Technology of Fruit and Vegetables by A. K. Thompson, 2nd edition, 2003
4. Post-harvest Technology of Fruit and Vegetables by K. Prasad, 1st edition, 2021
5. Post-harvest Management and Processing of Fruit and Vegetables by N.S. Rathore, G.K. Mathur, ICAR New Delhi.
6. Food Science by Norman N. Pottter, Joseph H. Hotchkiss 5th edition, 2007
7. Food Processing Technology: Principle and Practice P.J. Fellows 4th edition, 2017

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- III)

Course Code No.: MRT/MJ/552-T	No. of Credits: 02	Hours: 30
Course Title:	Drying of Farm Crops	

Learning Objectives

1. To familiarize students with concepts and fundamentals of drying and storage system
2. To enable students to apply basic concepts of drying and storage in real life situations.
3. To give students comprehensive knowledge of Solar dryer and modern storage structures its estimations.

Unit	Course Content	Periods
I	**Moisture Content** Moisture content and methods for determination, importance of EMC and methods of its determination, EMC curve and EMC model, principle of drying, theory of diffusion, mechanism of drying- falling rate, constant rate, thin layer, deep bed and their analysis, critical moisture content, drying models.	06
II	**Introduction of Drying** calculation of drying air temperature and air flow rate, air pressure within the grain bed, Shred's and Hukill's curve, different methods of drying including puff drying, foam mat drying, freeze drying, etc. Study of different types of dryers- performance, energy utilization pattern and efficiency, study of drying and dehydration of agricultural products.	06
III	**Introduction of Storage Structures** Study of different types of storage structures and causes of spoilage in storage, conditions for storage of perishable products, functional requirements of storage, control of temperature and relative humidity's inside storage, calculation of refrigeration load; modified atmospheric storage and control of its environment, air movement inside the storage, storage of grains	06
IV	**Mechanism of Storage Structures** Destructive agents, respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through natural ventilation, mechanical ventilation, artificial drying, grain storage structures such as Bukhari, Morai, Kothar, silo, CAP, warehouse - design and control of environment.	06
V	**Environmentally effect on stored grains** Storage of cereal grains and their products, storage of seeds, hermetically sealed and air-cooled storages-refrigerated, controlled atmosphere, modified atmospheric and frozen storages. Storage condition for various fruits and vegetables under cold and CA storage system. Economic, aspects of storage.	06

Learning Outcomes:

1. To acquire knowledge of about drying and storage of farm crops.
2. To use of drying and Storage methods in rural area.
3. To understand different drying and storage techniques for agricultural products.

Suggested Reading

1. A. S. Mujumdar, "Drying Technology in Agriculture and Food Science", Oxford and IBH Publishing House, 2000.
2. K. M. Sahay and K. K. Singh, "Unit Operations of Agricultural Processing", 2 nd edition, Vikas Publishing House, New Delhi, 2004
3. J. L. Multon, "Preservation and Storage of Grains, Seeds and their By-products: Cereals, Oil Seeds, Pulses and Animal Feed". 1 st edition, CBS Publishing and Distributions, Delhi, 1989.
4. S. Vijayaraghavan, "Grain Storage Engineering and Technology", 1 st edition, Batra Book Service, New Delhi, 1993.
5. W. L. McCab and J. C. Smith, "Unit Operation in Chemical Engineering", 7 th edition, McGraw Hill, Tokyo, 2005.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- IV)

Course Code No.: MRT/MJ/553-T	No. of Credits: 02	Hours: 30
Course Title:	**Rural Health Management**	

Learning Objectives

1. The core objectives of rural health science are to inform people, Build public opinion, Persuade, circulate government health policies, Disseminate health and education programmes, Help in facing epidemics, Highlight role and promote public health.
2. Bring awareness among the students about the dynamics of rural hearth.
3. Develop community based health learning for communicating rurally relevant health messages.

Unit	Course Content	Periods
I	**Introduction to health education:** concepts, objectives, philosophy, importance and need of health education in public health. Definition of Health education principles of hearth education. The role of the health education specialist in relation to other health personnel. Role of health education in the process of social change.	06
II	**National Health Programmes and eradication programmes:** National Malaria Eradication programme. Iodine deficiency disorders control programme. National programme for control of Blindness. National water supply and sanitation programme. National family welfare programme. Universal immunization programme. National STD /AIDS control programme. National Rural Health Mission, MDGs and pulse Polio Immunization.	06
III	**Health Programme Policies and Programmes:** Introduction: Basic concepts of occupational health and its components. Environment and industry: temperature, humidity, air movement and Radiation. Industrial toxicology. Occupational diseases Measures for control of industrial health disorders. Health hazards in agriculture. Preventive measures and role of health education in occupational health.	06
IV	**Environmental health and Environmental sanitation:** Components of environment man and his environment. Community sanitary survey (group assignment) problems in relation to water - sewage, refuse, air, food, housing and public places. Environment and Health: Need for improvement of environment, concepts of Environment. Environmental sanitation in the National plans: National schemes for Improvement of environment.	06
V	**Health survey and development reports:** History of health services in India. National plans: Planning commission and Five year plans: Interdependence in health, international health regulations - scope, objectives and functioning. WHO: constitution, objectives, plans of operation: assistance. UNICEF: constitution, objectives, functions, roles, various programmes. Other agencies like USAID.	06

Learning Outcomes:

1. After completion of the course the student will be able to address the challenges with suitable responses for the identified rural health issues engage in the management of the rural health.
2. Student will be Help to identify and accordingly respond to community health needs.
3. Student will be give insights of broader health issues and its impact on the rural health.

Suggested Reading

1. Annual Report 2001-2002, the Ministry of Health and Family Welfare, the Government of India, New Delhi.
2. Major Schemes and Programmes, 2000 (Nov.): The Ministry of Health and Family Welfare, the Government of India, New Delhi.
3. Parks Text Book of Preventive & Social Medicine, 1999 K.Park, Banarsidas Bhanot Publishers, Jabalpur.
4. Health for All –An Alternative Strategy, 1981: The Indian Council of Social Science Research & ICMR, New Delhi.
5. Banerjee, D., 1985: Health & Family Planning Services in India: The Epidemiological, Socio-cultural & Political Analysis and a Perspective , Lokprakashan, New Delhi
6. Rajaram, Bharathi and Narayanarao, Suresh and Hegde, Sukanya, Rural Healthcare Management (February 1, 2016). Partha S. Mukherjee (Dec. 30 2023) Understanding Public Health in Rural Populations of India.
7. Bill Auxier PhD, Nikki King, Tim Putnam (Aug 31 2023) Healthcare Leadership and Rural Communities Challenges, Strategies, and Solutions.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- V)

Course Code No.: MRT/MJ/554-P	No. of Credits: 02	Hours: 30
Course Title	**Lab-I: Commercial Plant Breeding**	

Learning Objectives:

1. To understand the Plant Breeding and its importance in Rural Development.
2. To understand the various commercial plant breeding methods.
3. To make students aware Techniques of Seed Production.

Unit	Course Content	Periods
I	1) To Study of Floral Biology in self-pollinated species 2) To Study of Floral Biology in cross pollinated species. 3) To Study of learning techniques in hybrid seed production using male-sterility in fields crops.	06
II	4) To Study of concept of rouging in seed production plot 5) To Study of concept of line, its multiplication and purification in hybrid seed production 6) To Study of pollinators in hybrid seed production	06
III	7) To Study of Sampling and analytical procedures for purity testing and detection of spurious seed 8) To Study of private seed production and processing plants 9) To Study of Techniques of seed production using two line systems in self and cross pollinated crops.	06
IV	10) To Study of Problems in hybrid seed production. 11) To Study of tools and Techniques for optimizing hybrid seed production. 12) To Study of Seed sampling.	06
V	13) To Study of Physical purity test and detection of spurious seed. 14) To Study of IPR issue in commercial plant breeding 15) To Study Economics of commercial seed production.	06

Learning Outcomes

1. The students will understand the Plant Breeding and its importance in Rural Development.
2. The students will get exposure to various challenges and problems with regard to availability and use of plant breeding.
3. The Students will demonstrate techniques of seed production perform relevant activities.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- VI)

Course Code No.: MRT/MJ/555-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-II: Food Processing Technology-I**	

Learning Objectives

1. To prepares students to operate enterprises related to crop production
2. To make students aware of technology in producing cereal grain, fibre, forage, oilseed, tree fruits and etc.
3. To get acquainted with crop cultivation practices, plant diseases, pest management, harvesting and marketing.

Unit	Course Content	Periods
I	1) To Study of agro processing in rural development 2) To Study of Post-harvest Technology. 3) To Study of Present scenario with reference to World, India, Maharashtra and Marathwada– Scope - extent of Post-harvest losses–causes of Post-harvest losses –salient features of Post-harvest Management	06
II	4) To Study of Steps in Post-harvest handling–Harvesting stages–maturity indices of fruits. 5) To Study of Steps in Post-harvest handling–Harvesting stages–maturity indices of vegetables, Sorting and Grading-Precooling, Pre-treatments 6) To Study of Pre-treatments- Importance of packing–Types of Packages used for packing of Commercial products- Methods of storage– transportation.	06
III	7) To Study of Post-harvest technology. 8) To Study of product diversification aspect of important crops like Sugarcane-Jaggery production, utilization of molasses, Cereals –Rice. 9) To Study of product diversification aspect of important Fruits like- Mango, banana, sapota, guava, Lemon; Spices–Ginger, Pepper, Turmeric; Plantation crops - Coconut, Commercial Flowers, etc	06
IV	10) To Study of food processing technology 11) To Study of Concept – steps and principles of food processing technology 12) To Study of important commercial food processing methods like - Canning, preparation of Jam, Jelly, Pickles, Squash, Marmalade, etc.	06

V	13) To Study of Entrepreneurship Development in Agri - based processing Industries. 14) To Study of Scope of self – employability – Present scenario – licensing. 15) To Study of FSSAI registration aspects - list of machineries used in processing Industry - marketing strategies.	06

Learning Outcomes:

1. Students will demonstrate knowledge of agricultural food industries including structure, production practices, and management principles.
2. Students will demonstrate effective application of food technology knowledge and resources to solve problems and perform relevant activities.
3. The students will get exposure to different technologies of food processing and will have hands on experience of preparation of various processed products

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- VII)

Course Code No.: MRT/MJ/556-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-III: Drying of Farm Crops**	

Learning Objectives

1. To familiarize students with concepts and fundamentals of drying and storage system.
2. To enable students to apply basic concepts of drying and storage in real life situations.
3. To give students comprehensive knowledge of Solar dryer and modern storage structures its estimations.

Unit	Course Content	Periods
I	1) To Determination of moisture content of the product. 2) To Study of mechanics of drying of grains. 3) To Study of Sun drying of fruits and vegetables.	06
II	4) To study of Problems using psychrometric chart. 5) To study of Design of Solar dryers. 6) To Design and layout of commercial bag storage facilities.	06
III	7) To Design and layout of commercial bulk storage facilities. 8) To Design and layout of commercial Morai storage facilities. 9) To Design and layout of commercial Bukhari storage facilities.	06
IV	10) To Design and layout of commercial Pusa bin storage facilities. 11) To study of Determination of EMC and ERH. 12) To study the effect of relative humidity and temperature on grains stored in gunny bags.	06
V	13) To Study of comparison between drying and dehydration. 14) To study of comparison between traditional and modern drying methods/storage structures. 15) To study of Visits to commercial handling and storage facilities for grains.	06

Learning Outcomes:

1. To acquire knowledge of about drying and storage of farm crops.
2. To use of drying and Storage methods in rural area.
3. To understand different drying and storage techniques for agricultural products.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- I)

Course Code: No: MRT/DSE/557-T	No. of Credits: 02	Hours: 30
Course Title:	**Green House Technology**	

Learning Objectives

1. To develop the broad, general understanding of the agricultural industry and the role it plays in today's world as well as look more specifically at the role of ornamental horticulture and the greenhouse industry
2. To develop the additional skills.
3. To make students aware of Greenhouse construction and management skill.

Unit	Course Content	Periods
I	**Introduction of Greenhouse Technology** Green house technology- Introduction , Components and design of green houses, Advantages, Applications in agriculture Fundamentals of Green House Technology	06
II	**Layout of Green houses** Structure and Construction of a Green House. Designing and layout of green house, laying the greenhouse	06
III	**Design of greenhouse and Poly house** Installation of greenhouse structure, erection of greenhouse structure Covering the greenhouse with nets and sheets	06
IV	**Maintenance of greenhouse** Checking the first time leakages through the gutter.	06
V	**Production Under Greenhouse Technology** Instruction in greenhouse structures and Greenhouse environment regulations. Plant growth, development and propagation, production and maintenance of bedding and container produced plants.	06

Learning Outcomes

1. The students will get acquainted with greenhouse and poly house technology
2. The Students will acquire the management skills for greenhouse.

3. The Students will comprehend knowledge and skills to get an employment or to become an entrepreneur in greenhouse sector.

Suggested Readings:

1. Greenhouse Technology for Controlled Environment, by G.N. Tiwari, 2009
2. Greenhouse Technology - Management, Operations & Maintenance, by N. N. Patil, 2016
3. Greenhouse Technology & Management by Nicolas Castilla and Esteban Baeza, 2012.
4. Greenhouse Technology & Management by Herna Dez Jose Del Sagrado, 2016
5. Greenhouse management of horticultural crops. 2nd Edition. Agrobios. Prasad S and Kumar U. 2003.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- II)

Course Code No.: MRT/DSE/558-P	No. of Credits: 02	Hours: 30
Course Title:	Lab-IV - Green House Technology	

Learning Objectives

1. To develop the broad, general understanding of the agricultural industry and the role it plays in today's world as well as look more specifically at the role of ornamental horticulture and the greenhouse industry.
2. To develop the additional skills.
3. To make students aware of Greenhouse construction and management skill.

Unit	Course Content	Periods
I	1) To Study of Preparation of different media as per need 2) To Study of Calculation of Fertilizer Dosage. Application of fertilizers as per need. 3) To Study of Design and Layout of Greenhouse.	06
II	4) To Study of Installation of Greenhouse Structures. 5) To Study of Maintenance of Greenhouse. 6) To Study of Maintain Health & Safety at the workplace.	06
III	7) To Study of Potential crop for green house 8) To Study of erection of greenhouse structure covering the greenhouse with nets and sheets. 9) To Study of Land survey and levelling for greenhouse.	06
IV	10) To Study of assessment of structural strength, foundation specifications. 11) To Study of Types of glazing material and its characteristics. 12) To Study of Understanding about basic safety checks for greenhouse.	06
V	13) To Study of operation of all machinery and vehicles and hazards for greenhouse. 14) To Study of Instruction in greenhouse structures and Greenhouse environment regulations. 15) To Study of Plant growth, development and propagation for greenhouse.	06

Learning Outcomes

1. The students will get acquainted with greenhouse and poly house technology
2. The Students will acquire the management skills for greenhouse.
3. The Students will comprehend knowledge and skills to get an employment or to become an entrepreneur in greenhouse sector.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- III)

Course Code No.: MRT/DSE/559-T	No. of Credits: 02	Hours: 30
Course Title:	Nursery Techniques Management	

Learning Objectives

1. To understand nursery for rural development
2. To be able to interpret grafting by using various propagation methods.
3. To understand layout of nursery and impact on crop growth.

Unit	Course Content	Periods
I	**Introduction about Nursery** Importance, Development. Establishment of Nursery -: Selection of site- Location, Soil and climate for Nursery, Topography, Wind, Elevation of Nursery place, Irrigation and Drainage facilities, Transportation and Marketing facilities, Labour facilities, Situation of Nursery, Free from all types of insects and diseases, Soil and preparation of Nursery.	06
II	**Lay out of Nursery** Bed Department, Construction Department, Water management Department, and Residential Department, Mother plants Department, Roads and Paths Department. Types of Nursery -: Multipurpose or mixed Nurseries, Mono-purpose or General Nursery, Specialized Nursery, Attached or auxiliary or subsidiary nursery.	06
III	**Location of Nursery** Scientific layout of Nursery, Collection of mother plant and their management, Source of available root stocks and their proper utilization, Testing and processing of seeds viability or seeds survival, Use of standard methods of plant propagation, Proper management of seed or storage, Arrangement of good selling, Proper testing facilities, Arrangement of Training and Demonstration, Arrangement of nursery exhibitions.	06
IV	**Nursery Management** Present location of Nursery in India, Suggestions for maximization of Nursery. Plant propagation, Sexual propagation (seed), Asexual propagation – Introduction, Division- suckers, runners, crown, rhizome, corm, tubers, bulb, bulbil, stolen, offset. Rootage- cutting, layering. Graftage- approach grafting, whip, tongue, cleft, saddle, side, veneer, bark, buttressing, epicotyle, bridge, double, Top working, Double working, Frame working.	06
V	**Plant growth regulators** Introduction, Types- Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene. Methods. Green house – Definition, Origin, Preparation, Structure, Types, Advantage. Polly House – Introduction, Structure, Size, Method, Advantage.	06

Learning Outcomes

1. Understand the importance of a plant nursery and basic infrastructure to establish it.
2. Explain the basic material, tools and techniques required for nursery.
3. Demonstrate expertise related to various practices in a nursery.

Suggested Readings

1. Plant Propagation And Nursery Husbandry - G.S. Saini (Hindi & English), 2021
2. A handboob for skill development Nursery Management of horticulture crops. By Deepa H. Dwivedi and Navaldey Bharti 2019.
3. Plant Propagation & Nursery Management by R.R. Sharma & Manish Shrivastav. 2004
4. Plant Propagation and Nursery Husbandry - - Dr. J.V.S. Yadav.
5. Plant Nursery Management: Principles and Practices, Central Arid Zone Research Institute (ICAR), Jodhpur, Rjasthan. Ratha Krishnan, M., et.al. (2014)
6. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 2. Kumar, N., (1997)
7. Plant Propagation, John Wiley & Sons, New Jersey. Kumar Mishra, K., N.K. Mishra and Satish Chand (1994).

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- IV)

Course Code No.: MRT/DSE/560-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Nursery Techniques Management**	

Learning Objectives

1. To understand nursery for rural development
2. To be able to interpret grafting by using various propagation methods.
3. To understand layout of nursery and impact on crop growth.

Unit	Course Content	Periods
I	1) To Study of basic concept of Nursery. 2) To Study of sexual propagation in Nursery. 3) To Study of asexual propagation in Nursery.	06
II	4) To Study of Classification of Nursery 5) To Study of Needs & availability in Nursery 6) To Study of Method of Graftage.	06
III	7) To Study of Scientific layout of Nursery. 8) To Study of Plant growth regulators. 9) To Study of different types of Polly House.	06
IV	10) To Study of Mother plants value in Nursery. 11) To Study of BIS (2008) standards related to Nurseries. 12) To Study of Seasonal and routine activities in plant Nurseries.	06
V	13) To Study of tools and Components of good Nurseries. 14) To Study of Common diseases observed in nurseries 15) To Study of role of government private sector participation, SHG's and NGOS in Nursery.	06

Learning Outcomes

1. Understand the importance of a plant nursery and basic infrastructure to establish it.
2. Explain the basic material, tools and techniques required for nursery.
3. Demonstrate expertise related to various practices in a nursery.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- V)

Course Code No.: MRT/DSE/561-T	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Climate Change**	

Learning Objective :

1. To increase awareness amongst the Concept of Climatology.
2. To be able to interpret climate change by using various weathering conditions.
3. To create and maintain a "Climate Change Condition" of major production areas so as to boost export of Agriculture Sector.

Unit	**Course Content**	**Periods**
I	Concept of Climatology Fundamental principles of climatology, Elements of climate, climate controls, Earth's radiation balance, Spatiotemporal variation of insolation, temperature, pressure, wind belts, humidity, cloud formation and precipitation, global hydrological cycle, water balance.	06
II	Weather and climate, Control of Climate, The Climate System , Climate Anamoly, Variability and change, Koppen's classification of Climate.	06
III	Impact of Climate Change Climate Change since the nineteenth century, Eustatic Changes, and role of oceans and forests as carbon sinks. Effects on organisms including humans; effects on ecosystems and productivity; species responses in terms of distribution ranges, adaptation; spread of diseases; Extinction risk for temperature-sensitive species; UV effects, Global warming and its manifestation on Climate Change, Influence of Extra-terrestrial forces on Climate Change including variation in atmospheric soil and ocean temperature.	06
IV	Climate of India, clouds and precipitation, Possible Global climate Change, Greenhouse effect, Greenhouse gases, stratospheric ozone, Strategies for protecting stratospheric ozone.	06
V	Pollution: definition, causes, effects and control measures of Air pollution, water pollution, soil pollution, Noise pollution, Pollution case studies.	06

Learning Outcomes

1. The students will be able to describe the fundamentals of atmosphere, hydrosphere, lithosphere, pedosphere and biosphere.
2. Present the international climate change legal and policy framework and explain key issues under negotiation.
3. The students will be able to justify the role and responsibility of Indian Industry in climate change.

Suggested Readings

1. Ruddiman W F, Earth's Climate past and Future, W.H. Freeman, 2007
2. Bengtsson F. O., Geosphere Biosphere Interaction and Climate, Cambridge University Press, 2001
3. Berdowski J., Guichert R. and Heil B., The Climate System, A.A. Blakema Publisher, 2000
4. Hardy J. T., Climate Change: Causes, effects and solutions, John Wiley and Sons, 2003
5. Barry, R. G., 2003. Atmosphere, weather and climate. Routledge Press, UK Ellis,
6. Firor, J., & Jacobsen, J. E. 2002. The crowded greenhouse: population, climate change and creating a sustainable world. Yale University Press.
7. Graham, S. 2000. https://earthobservatory.nasa.gov/Features/Milankovitch/ Harvey, D. 2000. Climate and Global Climate Change, Prentice Hall.
8. Huybers, P. and Curry, W. 2006. Links between annual, Milankovitch and continuum temperature variability. Nature, 441: 329
9. Mukherjee, S., Extra-terrestrial Influence on Climate Change, Springer, 2013.
10. Foken, T.; Micrometeorology. Springer-Verlag, Berlin, Heidelberg, 2008.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- VI)

Course Code : MRT/DSE/562-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Climate Change**	

Learning Objective :

1. To increase awareness amongst the Concept of Climatology.
2. To be able to interpret climate change by using various weathering conditions.
3. To create and maintain a "Climate Change Condition" of major production areas so as to boost export of Agriculture Sector.

Unit	Course Content	Periods
I	1) To Study of Fundamental principles of climatology. 2) To Study of climate change impacts on agriculture and health. 3) To Study of climate change Impacts on Crops, crop cycles, soil quality and soil organic carbon.	06
II	4) To Study of climate change Impacts on Livestock, fodder production and availability, livestock crisis management. 5) To Study of Impacts on Fisheries, fishing cycles and local community impacts due to change in fishing cycles. 6) To Study of Climate change impacts on forests and transportation	06
III	7) To Study of Climate Change Impacts on Water Cycle. 8) To Study of Uncertainty and climate change policy 9) To Study of Climate change impacts on energy and socioeconomic issues.	06
IV	10) To Study of Climate and Energy Systems and its relevance to various stakeholders in the energy sector. 11) To Study of the effects of climate change on power & heat plants – assessing the risks and opportunities. 12) To Study of Renewable sources, production mechanisms, project planning for Solar PV, wind generation farms.	06
V	13) To Study of Forest biomass for fuel production – potentials, management and risks under warmer climate. 14) To Study of Climate change policy of countries, India and Gujarat. 15) To Study of Policy implications-case studies of successful implementations.	06

Learning Outcomes

1. The students will be able to describe the fundamentals of atmosphere, hydrosphere, lithosphere, pedosphere and biosphere.
2. Present the international climate change legal and policy framework and explain key issues under negotiation.
3. The students will be able to justify the role and responsibility of Indian Industry in climate change.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ON JOB TRAINING)

Course Code : MRT/OJT/563-P	No. of Credits: 04	Course Title: On Job Training
		Hours : 08 Hrs./Week

Learning Objective :

1. To increase awareness amongst the concept of rural technology.
2. To be able to interpret on job training ideas using various weathering conditions.
3. To create and maintain a "double income for farmer" of major production areas so as to boost export of Agriculture Sector.

Additional job training ideas tailored for them

1) **Field Research Assistantships:** Partner with local research organizations, NGOs, or governmental agencies to provide students with opportunities to assist in ongoing field research projects related to rural technology. This could involve habitat surveys, technology assessments, or monitoring endangered species

2) **Internships with Rural Technology NGOs**: Collaborate with technology-focused non-profit organizations to offer internships where students can get involved in technology projects, community outreach programs, and policy advocacy initiatives

3) **Wildlife Rehabilitation Centres**: Students can gain valuable experience by volunteering or interning at wildlife rehabilitation centres. Here, they can learn about renewable energy sources, rehabilitation techniques, and the challenges faced in rural technology first-hand

4) **Botanical Gardens or Arboreta Internships**: Botanical gardens and arboreta often have horticulture-focused programs where students can assist in plant conservation efforts, learn about seed banking, rare plant propagation, and habitat restoration

5) **GIS and Remote Sensing Training**: Offer training workshops or courses in Geographic Information Systems (GIS) and remote sensing techniques specific to rural technology. These skills are highly valuable for analysing and mapping habitats, tracking species distributions, and identifying conservation priorities.

6) **Community-based rural technology Projects**: Encourage students to collaborate with local communities on rural technology initiatives. This could involve organizing rural technology education workshops, conducting renewable energy sources surveys with community participation, or implementing sustainable livelihood projects.

7) **Agriculture Genetics Laboratories**: Provide opportunities for students to work in conservation genetics laboratories where they can learn about DNA sequencing, population genetics analysis, and its applications in agriculture sector.

8) **Rural Technology Policy and Advocacy**: Offer training sessions or workshops focused on rural technology policy and advocacy, where students can learn about environmental law, policy-making processes, and strategies for effective advocacy on rural technology issues.
9) **Ecotourism and Interpretation Programs**: Partner with eco-lodges, nature reserves, or ecotourism operators to provide training in ecotourism management and interpretation techniques. This can help students understand the importance of sustainable tourism in conservation efforts and develop skills in agriculture education and interpretation.
10) **Rural Technology Impact Assessment (RTIA) Training**: RTIA is a critical component of many rural technology projects. Providing training in RTIA methodologies and procedures can equip students with skills necessary for assessing the potential agriculture impacts of development projects and proposing measures.

Learning Outcomes

1. The students will be able to describe the condition of rural area.
2. The students will be able to justify the role and responsibility of agriculture value in rural area.
3. Describe the expected consequences of rural technology and the role of agriculture sector.

Note: Any other areas relevant to the concerned subject

For M.Sc. Rural Technology students, hands-on training experiences are crucial for honing their skills and preparing them for the field. These training opportunities enhance student's practical skills but also provide them with valuable networking opportunities and real-world experiences that can boost their career prospects in the field of rural technology.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(FIELD PROJECT)

Course Code : MRT/FP/563-P	No. of Credits: 04	Course Title: Field Project
		Hours : 08 Hrs./Week

Learning Objective :

1. To increase awareness amongst the concept of rural technology.
2. To be able to interpret field project ideas using various weathering conditions.
3. To create and maintain a "double income for farmer" of major production areas so as to boost export of Agriculture Sector.

Additional field project ideas for the subject area

1) Evaluation of Plant-Insect Interactions in Agro ecosystems: Implications for Pest Management.
2) Investigating the Role of Keystone Species in Maintaining Ecosystem Stability.
3) Characterization of Proximate analysis in substrate: Potential for Biogas.
4) Analysis of Rural Technology and Habitat Preferences in Urban vs. Rural Landscapes.
5) Comparative Study of Traditional vs. Molecular Taxonomic Approaches in Species Identification.
6) Assessment of Genetic Variation in Wild and Cultivated Populations of Medicinal Plants.
7) Mapping Wetland Ecosystems and Assessing Their Contribution to Biodiversity Conservation.
8) Exploring the Issues of rural technology on Wildlife Corridors and Connectivity.
9) Evaluation of Remote Sensing Techniques for Monitoring Coral Reef Health
10) Investigating the Effects of Land Use Change on Soil Microbial Community Composition.
11) Assessment of Genetic Diversity & Population Structure of Amphibians in Fragmented Habitats.
12) Assessment of comparison between primary and secondary nutrient.
13) Investigating the Role of Microbial Communities in Soil Nutrient Cycling and Productivity.
14) Assessing the Impacts of Invasive Plant Species on Native Flora and Fauna.
15) Exploring the Relationship Between evaporation and transpiration.

Learning Outcomes

1. The students will be able to describe the condition of rural area.
2. The students will be able to justify the role & responsibility of agriculture value in rural area.
3. Describe the expected consequences of rural technology and the role of agriculture sector.

Note: Any other areas relevant to the concerned subject

These additional project ideas cover various aspects of rural technology, ecosystem dynamics, and the application of biotechnological and phylogenetic approaches in understanding and managing natural systems. Students can select or modify these topics based on the interest, available resources and research objectives. "Students are encouraged to propose their own field project topics within the course's scope, focusing on rural technology, taxonomy, remote sensing, solar energy wind power botany horticulture floriculture food technology and etc. Projects should align with personal interests and contribute to understanding rural technology efforts. Approval from the Subject Teacher is required for project selection."

16. Curriculum for Semester – III

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: III Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MRT/MJ/600-T	Watershed Management –II	2		2		14
	MRT/MJ/601-T	Food Processing Technology-II	2		2		
	MRT/MJ/602-T	Rural Tourism	2		2		
	MRT/MJ/603-T	ICT in Rural Technology	2		2		
	MRT/MJ/604-P	Lab-I: Watershed Management – II		4		2	
	MRT/MJ/605-P	Lab-II: Food Processing Technology-II		4		2	
	MRT/MJ/606-P	Lab-III: Rural Tourism		4		2	
DSE (Choose any one from pool of courses)	MRT/DSE/607-T	Organic Farming	2		2		04
	MRT/DSE/608-P	Lab-IV: Organic Farming		4		2	
	or	or					
	MRT/DSE/609-T	Medicinal and Aromatic Plants	2		2		
	MRT/DSE/610-P	Lab-IV: Medicinal and Aromatic Plants		4		2	
	or	or					
	MRT/DSE/611-T	Environment & Disaster Management	2		2		
	MRT/DSE/612-P	Lab-IV: Environment & Disaster Management		4		2	
RP-1	MRT/RP-I/613-P	Research Project-I		4		4	04
			10	20	10	12	22 Credits

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- I)

Course Code No.: MRT/MJ/600-T	No. of Credits: 02	Hours: 30
Course Title	**Watershed Management –II**	

Learning Objectives:

1. To understand the integrated watershed management and its importance in Rural Development.
2. To understand the various watershed management methods.
3. To make students aware Techniques of Rainwater conservation.

Unit	Course Content	Periods
I	**Watershed development-** Problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, Present land use practices and socio-economic factors.	06
II	**Watershed management –** concept, objectives, factors affecting, Integrated watershed management - concept, components	06
III	**Management measures –** Rainwater conservation technologies - in-situ and ex-situ storage. Water harvesting and recycling. Dry farming techniques - inter-terrace and inter-bund land management.	06
IV	**Participatory watershed management –** Role of watershed associations, user groups and self-help groups. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.	06
V	**Watershed programme –** Execution, follow-up practices, maintenance, monitoring and evaluation.	06

Learning Outcomes

1. The students will understand the Dry farming techniques and its importance in Rural Development.
2. The students will get exposure to various challenges and problems with regard to availability and use of watershed management programme.

3. The Students will demonstrate techniques of watershed management perform relevant activities.

Suggested Readings:

1. Soil Conservation and Land Management. S. K. Datta, International Book Distributors, Dehradun, 1985
2. Soil and Water Conservation Engg. R. Suresh, Standard Publishers Distributors, Delhi-6, Reprint Edition 2006
3. Watershed Planning and Management. Rajvir Singh. Yash Publishing House, Bikaner. 2000
4. Field Manual on Watershed Management. 2013. B. Venkateswarlu, Mohammed Osman, M.V. Padmanabhan, K. Kareemulla, P.K. Mishra, G.R. Korwar & K.V. Rao, CRIDA, Hyderabad
5. Hydrology and Soil Conservation Engineering: Including Watershed Management. Ghanshyam Das, 2008. Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
6. Hydrology. H. N. Raghunath. New Age International Publishers, 2004 reprint.
7. Watershed Management. V.V. DhruvaNarayana G. Sastry& U.S. Patnaik. ICAR, New Delhi, 1997
8. Watershed Management: Guidelines for Indian Conditions. Tideman, E.M., Omega Scientific Publishers, New Delhi. 1996
9. Watershed Management: Design and Practice. P. K. Singh, 2000. E-media Publications, Udaipur.
10. Katyal, J.C., R.P. Singh, Shriniwas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field Manual on Watershed Management. CRIDA, Hyderabad.
11. Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.
12. Sharda, V.N., A.K. Sikka and G.P. Juyal. 2006. Participatory Integrated Watershed Management: A Field Manual. Central Soil and Water Conservation Research and Training Institute, Dehradun.
13. Singh, G.D. and T.C. Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- II)

Course Code No.: MRT/MJ/601-T	No. of Credits: 02	Hours: 30
Course Title	**Food Processing Technology-II**	

Learning Objectives:

1. To understand the pasteurization and sterilization method in Rural Milk Farm.
2. To understand the various Food Freezing and thawing process.
3. To make students aware Techniques of Food Concentration.

Unit	Course Content	Periods
I	**Food processing and preservation principles, method of preservation:** pasteurization (definition, time-temperature combination and equipments) sterilization (definition, time-temperature combination and equipments), blanching (definition, time-temperature combination and equipments, adequacy in blanching), canning (definition, time-temperature combination and equipments), packaging (Introduction, Metal Containers, Glass Containers, Rigid Plastic Containers, Retortable Pouches)	06
II	**Food Freezing and thawing process:** Introduction, freezing point and freezing rate, comparison of Freezing and thawing process; freezing methods: Air freezing, plate freezing, liquid immersion freezing and cryogenic freezing. Freezer selection. Advantages and disadvantages of freezing. Freezing curve. Freezer selection, advantages and disadvantages of freezing and changes in food during freezing storage	06
III	**Food Drying/Dehydration:** Definition, free and bound moisture, concept of water activity, factors affecting drying, Drying curve (constant rate period and falling rate period), moisture content (wet basis and dry basis), equilibrium moisture content,	06
IV	**Food Concentration:** Evaporation- Definition, types of evaporator (single effect, double effect and multiple effect evaporator); Freeze concentration- General principles and applications, basic elements, ice crystal nucleation, growth and crystallization, separation techniques (filtration and wash column).	06

V	**Membrane Processing:** General principles and advantages, dead end and cross flow, Classification of membrane system: Reverse Osmosis, Nano Filtration, Ultra Filtration, Micro Filtration, Electodialysis and Pervaporation; Membrane technology comparison chart, Membrane application in the food industries; Membrane performance, and Limitation of membrane processes.	06

Learning Outcomes

1. The students will understand the Dairy farming techniques and its importance in Rural Development.
2. The students will get exposure to various challenges and problems with regard to availability and use of food processing.
3. The Students will demonstrate techniques of food product perform relevant activities.

Suggested Readings:

1. Food Processing: Principles and Applications by Ramaswamy H. & Marcotte M. Taylor & Francis.
2. Food Science by Norman N Potter and Joseph H. Hotchkiss, CBS Publishers and Distributors.
3. Novel Food Processing Technologies by Barbosa-Canovas, Tapia & Cano CRC Press, 2004.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- III)

Course Code No.: MRT/MJ/602-T	No. of Credits: 02	Hours: 30
Course Title:	**Rural Tourism**	

Learning Objectives

1. To familiarize students with concepts and fundamentals of tourism, tourism in world, in India, in Maharashtra
2. To enable students, thorough understand tourism
3. To give students comprehensive knowledge of Models of sustainable tourism in India.

Unit	Course Content	Periods
I	Introduction, Tourism, types of tourism, tourism in world, in India, in Maharashtra, tourism in past, present trends and foresight models of tourism, tourism & sustainable development, sustainable tourism, social tourism, rural tourism. Market share of tourism in world market, world tourism day & motto, Rural tourism & India.	06
II	Rural Tourism in India, its scope & importance, rural society of India, cultural aspects of India & tourism, Models of sustainable tourism in India, Rural Tourism components & types of rural tourism	06
III	Economics of tourism, GDP share of tourism in India. Opportunities for development of rural tourism, Challenges in development of rural tourism, benefits & hazards of rural tourism, rural tourism & employment generation in rural India.	06
IV	Development of rural tourism, selection of theme, selection of site, planning of rural tourism theme, execution of rural tourism theme, promotion & marketing of rural tourism theme, management of resources, security & service, guests feedback	06
V	Practical experience & project on rural Tourism, Presentation of case study, development of rural tourism model. Field visit.	06

Learning Outcomes:

1. Acquire knowledge of rural tourism model
2. Use of rural tourism theme
3. Understand different management of resources, security & service.

Suggested Readings

1. "Strategic Development Policies and Impact Studies of Sustainable Rural and Community- Based Tourism (Ju-pb) 2014 by Parikshat Singh Manhas and Deepak Raj Gupta
2. Rural Tourism, by R. Prudhi
3. Rural Tourism and Tribal Development1 December 2006 by S.B. Verma and S.K. Jiloka
4. Rural Tourism: New Concepts, New Research, New Practice19 September 2017 by Bernard Lane and Elisabeth Kastenholz
5. International rural tourism development: an Asia-Pacific perspective1 July 2017 by World Tourism Organization
6. Tourism and Rural Management2 September 2013 by Dr. Rais Ahmad.

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(MANDATORY SUBJECT- IV)

Course Code No.: MRT/MJ/603-T	No. of Credits: 02	Hours: 30
Course Title:	**ICT in Rural Technology**	

Learning Objectives

1. The objective of this paper is to give general background of ICT and its components for Rural Development.
2. Elaborate the Methods, Techniques and Procedures to implement ICT for Rural Development.
3. To enable students, thorough understand ICT for Rural Technology

Unit	Course Content	Periods
I	Concept of Development and growth in general, Distinction between growth and Development, Indicators of Development, Measures of Development. Concept of Rural Development, Causes of Rural Backwardness, Need for Rural Development, Constraints and Scope of Rural Development.	06
II	Basics of computer Hardware's and Software's. Concepts and Applications of Intranet (LAN, WAN, Topology) and Internet (WWW, Web Browsers, Surfing, Search Engines, Downloading, Email, Skyping etc.).Concepts and Principles of ICT, Components of ICT. Scopes of ICT in Rural Development.IOT for Rural Development.	06
III	Basic concepts of Remote Sensing (RS), Global Positioning System (GPS) and Geographic Information Systems (GIS) and various data formats. Generation of Resource data, Sources acquisition, structure, transformation into map/diagram/visual presentation for better comprehension. Handling Geospatial Data using Data Analysis Tools (i.e. QGIS, GRASS GIS, and ILWIS).	06
IV	Applications of ICT in E-Gram Panchayat,E-Agriculture,E-Water Management,E-Weather Forecasting,E-Education,E-Health, E- Governance, E-Banking, E-Marketing, E-Insurance, E-fulfillment and customer relationship management.	06
V	Case Studies, Demonstrationsand Field Work: Example: -Rural:MGNREGA, Watersheds, E-Governance: Decentralized Planning, Agricultural:Plantation, Geo-tagging of RashtriyaKrishiVikasYojana (RKVY), Pest Surveillance, PradhanMantriKrishiSinchayeeYojana (PMKSY), Water: Water Body Information System (WBIS), Satellite Based Accelerated Irrigation Benefit Program (AIBP), Ground Water Prospects Information System – (GWIS), Any other relevant Government/ NGO scheme.	06

Learning Outcomes:

1. Students will get clear understanding about the Information and Communication Technology (ICT) and its components for Rural Development.
2. Students will be able to grasp and manage use of ICT in various fields like E-Gram Panchayat, Agriculture, Water Management, Education, Health, Economic Development, Banking, Insurance, and Marketing.
3. Student will be Help to identify and accordingly respond to ICT in various fields.

Suggested Reading

1. Singh, Katar. : Rural Development – Principles, Policies and Management, Sage Publications. New Delhi.
2. Sundaram, Satya, I.: Rural Development, Himalaya Publishing.
3. Goel, A. (2010). Computer fundamentals. Pearson Education India.
4. Sinha, P. K., &Sinha, P. (2010). Computer fundamentals (Vol. 4). BPB publications.
5. Calasso, M. P. (2016). Information and communication technology for sustainable development.
6. Schowengerdt, R. A. (2006). Remote sensing: models and methods for image processing. Elsevier.
7. Chang, K. T. (2015). Introduction to geographic information systems. McGraw-Hill Science/Engineering/Math.
8. Reddy, M. A., & Reddy, A. (2008). Textbook of remote sensing and geographical information systems (p. 453). Hyderabad: BS publications.
9. Abdalla, R. (2016). Introduction to Geospatial Information and Communication Technology (Geo ICT). Springer.
10. Goswami, D., Bhattacharya, S., & Barbhuiya, F. A. (2012). Information and Communication Technology for Education, Healthcare and Rural Development. Narosa Pub House.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- V)

Course Code No.: MRT/MJ/604-P	No. of Credits: 02	Hours: 30
Course Title	**Lab-I: Watershed Management –II**	

Learning Objectives:

1. To understand the integrated watershed management and its importance in Rural Development.
2. To understand the various watershed management methods.
3. To make students aware Techniques of Rainwater conservation.

Unit	Course Content	Periods
I	1) To Study of Surveying and preparation of watershed map 2) To Study of Grid survey of watershed area 3) To Study of Preparation of contour map and delineation of watershed	06
II	4) To Study of Delineation of watersheds using top sheets. 5) To Study of Quantitative analysis of Geo-morphological characteristics of watershed 6) To Study of Analysis of hydrologic data for planning of watershed development	06
III	7) To Study of Water budgeting of watersheds 8) To Study of Prioritization of watersheds based on sediment yield index 9) To Study of Watershed planning and development	06
IV	10) To Study of Watershed management technologies. 11) To Study of Practice on software's for analysis of hydrologic parameters of watershed 12) To Visit of watershed development project.	06

V	13) To Study of Watershed resources 14) To Study of issue in Watershed resources 15) To Study remedies on Watershed resources	06

Learning Outcomes

1. The students will be able to describe the fundamentals of atmosphere, hydrosphere, lithosphere, pedosphere and biosphere.
2. Present the international climate change legal and policy framework and explain key issues under negotiation.

The students will be able to justify the role and responsibility of Indian Industry in climate change.

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(MANDATORY SUBJECT- VI)

Course Code No.: MRT/MJ/605-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-II: Food Processing Technology-II**	

Learning Objectives

1. To understand the pasteurization and sterilization method in Rural Milk Farm.
2. To understand the various Food Freezing and thawing process.
3. To make students aware Techniques of Food Concentration.

Unit	Course Content	Periods
I	1) To Study of Food processing and preservation 2) To Study of pasteurization 3) To Study of sterilization	06
II	4) To Study of blanching 5) To Study of canning 6) To Study of packaging	06
III	7) To Study of Food Freezing and thawing process 8) To Study of freezing method 9) To Study of Food Drying/Dehydration	06
IV	10) To Study of Drying methods and equipment's 11) To Study of Food Concentration 12) To Study of Freeze concentration	06
V	13) To Study of Membrane Processing 14) To Study of Classification of membrane system 15) To Study of Membrane application in the food industries.	06

Learning Outcomes

1. The students will understand the Dairy farming techniques and its importance in Rural Development.
2. The students will get exposure to various challenges and problems with regard to availability and use of food processing.
3. The Students will demonstrate techniques of food product perform relevant activities.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- VII)

Course Code No.: MRI/MJ/606-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-III: Rural Tourism**	

Learning Objectives

1. To familiarize students with concepts and fundamentals of tourism, tourism in world, in India, in Maharashtra
2. To enable students, thorough understand tourism
3. To give students comprehensive knowledge of Models of sustainable tourism in India.

Unit	Course Content	Periods
I	1) To study of tourism in world 2) To study of tourism in India. 3) To study of tourism in Maharashtra	06
II	4) To study of tourism in past, present trends and foresight models of tourism, 5) To study of tourism & sustainable development. 6) To study of social tourism.	06
III	7) To study of rural tourism. 8) To study of Market share of tourism in world market. 9) To study of world tourism day & motto, rural tourism & India.	06
IV	10) To study of cultural aspects of India & tourism. 11) To study of Economics of tourism. 12) To study of Challenges in development of rural tourism, benefits & hazards of rural tourism.	06
V	13) To study of Development of rural tourism, 14) To study of management of resources, security & service. 15) To study of Practical experience & project on rural Tourism.	06

Learning Outcomes:

1. Acquire knowledge of rural tourism model
2. Use of rural tourism theme.
3. Understand different management of resources, security & service.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- I)

Course Code: No: MRT/DSE/607-T	No. of Credits: 02	Hours: 30
Course Title:	**Organic Farming**	

Learning Objectives

1. To create awareness about Organic farming
2. To equip learners with the knowledge and skills necessary to practice sustainable agriculture and the production of healthy, organic food.
3. To introduce the concept of organic ecosystem and learn about biological magnification and its significance in present day scenario.

Unit	Course Content	Periods
I	**INTRODUCTION** History and development, IFOAM, Definition and Principle- health, fairness, ecology and care, Methods, advantages and limitations, Need of Organic farming in present context and future prospects- barrier	06
II	**ORGANIC ECOSYSTEM & THEIR CONCEPT** Structure and function, Productivity, Decomposition, Nutrient cycling, Eutrophication, Biological magnification	06
III	**SOIL** Definition, Composition of Soil- Soil texture and Types, Soil structure, Soil Profile, Humus & Soil pH, Role of Soil in Organic Farming, Soil factors affecting plant Growth: light, heat, water, humidity, pH and Nutrition, C: N ratio of good fertile Soil	06
IV	**PLANT NUTRITION** Structural organization & function of different Plant organ, Plant nutrient- Micro and Macro, Importance & Deficiency Symptoms, Sources : Organic, Green manure- Method of composting, Benefit & Limitations, Soil microorganism: Mycorrhiza, Rhizosphere- Significance	06
V	**ORGANIC FARM MANAGEMENT** Land preparation - Tools and Technique, Preparation of seed bed , manuring, sowing, watering and raising of seedling	06

Learning Outcomes

1. Practical Skill: Students will gain hands on experience through field work, farm visits or practical exercises to apply their knowledge in a real world setting.

2. Soil health and fertility: learners will explore the significance of soil health in organic Farming and various methods to enhance soil fertility through composting and crop rotation.
3. Marketing and Economics: Students will learn about marketing organic products, understanding consumer demand and the economic aspect of Organic farming.

Suggested Readings:

1. Sharma, Arun K. 2002. A Handbook of Organic farming. Agrobios, India.
2. Sathe, T.V. 2004, Vermiculture and Organic Farming. Daya Publishers.
3. Alvares, C. 1996. The Organic Farming Source Book. The Other India Press, Mapusa, Goa.
4. Gupta, M., 2004. Organic Agriculture Development in India. ABD publishers, Jaipur, India.
5. S.P. Palaniappan, K. Annadurai, 1999. Organic Farming- Theory and Practice, Scientific Publishers, Jodhpur, India.
6. Dr. Pratiksha Raghuvanoki. Handbook of Organic Farming.
7. Organic Farming: The Ecological System- Agronomy Monograph 54, ASA, USA.
8. Subha Rao, N.S. 200, Soil Microbiology, Oxford & IBH Publishers, New Delhi
9. Dongarjal R. P. and Zade S.B. 2019. Insect Ecology and Integrated Pest Management, Akinik Publications, New Delhi.
10. Guideline of National Project on Organic Farming, Department of Agriculture and Cooperation, INM Division, Ministry of Agriculture, Govt. of India
11. Dushyent Gehlot. 2005. Organic Farming- standards, accreditation, certification and inspection. Agribios, India.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- II)

Course Code No.: MRT/DSE/608-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Organic Farming**	

Learning Objectives

1. To create awareness about Organic farming
2. To equip learners with the knowledge and skills necessary to practice sustainable agriculture and the production of healthy, organic food.
3. To introduce the concept of organic ecosystem and learn about biological magnification & its significance in present day scenario.

Unit	Course Content	Periods
I	1) To Study of Preparation of Organic Compost-Over ground compost, Pit compost, Liquid compost, Vermi compost 2) To Study of Preparation of Neem products and other botanicals for Pest and disease control 3) To Study of Weed control through organic way	06
II	4) To Study of Soil analysis: pH determination 5) To Study of Seed bed preparation 6) To Study of seed selection	06
III	7) To Study of seedling preparation 8) To Study of Method of application of different types of fertilizer and Green manure 9) To Study of effect of Preparation of Panchagavya / Amrit Jol	06
IV	10) To Study of Organic Ecosystem 11) To Study of Soil factors affecting plant Growth 12) To Study of Role of Soil in Organic Farming	06

V	13) To Study of Plant nutrient- Micro and Macro, Importance & Deficiency Symptoms 14) To Study of Sources : Organic, Green manure- Method of composting, Benefit & Limitations 15) To Visit of Organic farm to study the various components, identification and utilization of Organic products	06

Learning Outcomes

1. Practical Skill: Students will gain hands on experience through field work, farm visits or practical exercises to apply their knowledge in a real world setting.
2. Soil health and fertility: learners will explore the significance of soil health in organic Farming and various methods to enhance soil fertility through composting and crop rotation.
3. Marketing and Economics: Students will learn about marketing organic products, understanding consumer demand and the economic aspect of Organic farming.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- III)

Course Code No.: MRT/DSE/609-T	**No. of Credits: 02**	**Hours: 30**
Course Title:	**Medicinal and Aromatic Plants**	

Learning Objectives

1. To understand different use of Medicinal Plants
2. To be able to interpret Medicinal plant conservation – issues and approaches.
3. To understand land use impact of Taxonomic descriptions and uses of important aromatic plants

Unit	Course Content	Periods
I	MAPs: definition, history, importance and future prospects. Medicinal Plants – past and present status in world and India. MAPs as industrial crops - constraints and remedial measures. Medicinal plant diversity & local healthcare. Medicinal plant conservation – issues and approaches. Medicinal plant conservation areas (MPCA), Non-timber forest products (NTFP), Good Agriculture Practices (GAP). Indian Himalayan region (IHR).	06
II	Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. Other organizational initiatives for promotion of MAPs at National and International levels. Demand and supply of medicinal plants. Herbal industries.	06
III	Important medicinal plants of India with their systematics, geographical distribution and uses. Acorus calamus, Adhatoda vasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona.	06
IV	Important aromatic plants of India with their systematics, geographical distribution and uses. Introduction and historical background of aromatic plants. Aromatic and cosmetic products. Raw material for perfumes etc. Cosmetic Industries. Major, minor and less known aromatic plants of India	06

V	Taxonomic descriptions and uses of important aromatic plants – citronella, davana, damask rose, geranium, khus grass, large cardamom, lavender, lemon grass, mentha, holy basil, patchouli, rosemary Palmarosa, vetiver, artemisia, eucalyptus, thyme, marjoram and oreganum. Aromatic spices - clove, cinnamon, nutmeg, dill, celery, tamarind, garcinia, curry leaf and saffron.	06

Learning Outcomes

1. Suggest use of Medicinal Plants
2. Assess the current status of the Medicinal and Aromatic Plants at field, by taking up accurate investigation measures and conduct survey
3. Suggest Medicinal and Aromatic Plants in drought area.

Suggested Readings

1. Medicinal Plants of Uttarakhand by C.P. Kala (2010)
2. Indian Medicinal Plants by P.C. Trivedi (2009).
3. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
4. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
5. Handbook of MAPs by S.K. Bhattacharjee (2009).

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- IV)

Course Code No.: MRT/DSE/610-P	No. of Credits: 02	Hours: 30
Course Title:	Lab-IV - Medicinal and Aromatic Plants	

Learning Objectives

1. To understand different use of Medicinal Plants
2. To be able to interpret Medicinal plant conservation – issues and approaches.
3. To understand land use impact of Taxonomic descriptions and uses of important aromatic plants

Unit	Course Content	Periods
I	1) To Study of MAPs: definition, history, importance and future prospects. 2) To Study of Medicinal Plants – past and present status in world and India. 3) To Study of MAPs as industrial crops - constraints and remedial measures.	06
II	4) To Study of Medicinal plant diversity & local healthcare. 5) To Study of Medicinal plant conservation – issues and approaches 6) To Study of Medicinal plant conservation areas (MPCA)	06
III	7) To Study of Non-timber forest products (NTFP) 8) To Study of Good Agriculture Practices (GAP) 9) To Study of Promotion of medicinal plant sector at national level	06
IV	10) To Study of national Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. 11) To Study of Demand and supply of medicinal plants. 12) To Study of Herbal industries.	06
V	13) To Study of Important medicinal plants of India with their systematics, geographical distribution and uses. 14) To Study of Acorus calamus, Adhatoda vasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona 15) To Study of Aromatic spices - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curryleaf and saffron.	06

Learning Outcomes

1. Suggest use of Medicinal Plants
2. Assess the current status of the Medicinal and Aromatic Plants at field, by taking up accurate investigation measures and conduct survey.
3. Suggest Medicinal and Aromatic Plants in drought area.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- V)

Course Code No.: MRT/DSE/611-T	No. of Credits: 02	Hours: 30
Course Title:	**Environment & Disaster Management**	

Learning Objective :

1. Gain knowledge on Environment, its structure, climate change, sustainable development, disaster management, different type of diseases and public health management.
2. Learner lay foundation on the concept of disaster management, vulnerability, assessment and risk analysis, institutional framework, preparedness measures and survival skills.
3. The learner develop understanding on the Environment, ecosystem, biogeochemical cycle, environmental pollution and capability to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.

Unit	Course Content	Periods
I	**The Environment** The Introduction of Environment, Ecosystem and Biogeochemical Cycle, Environmental Pollution, Environmental Laws	06
II	**Climate Change and Sustainable Development** Population Ecology, Population Growth and Controls, Climate Change, Sustainable Development	06
III	**Disaster Management** The Introduction of Disaster Management, Vulnerability Assessment and Risk Analysis, Institutional Framework, Preparedness Measures and Survival Skills	06
IV	**Public Health Management** Communicable/Non-communicable diseases and Dynamics of Diseases Transmission, Brief Idea on Epidemic & Pandemic and its prevention, Life Style Management, Role of Different Sector in Managing Health Disaster	06
V	**Critical issues in public health management** Gain insight into historical, contemporary perceptive on communicable and non-communicable disease, life style management, Transmission of epidemic- pandemic diseases and its prevention	06

Learning Outcomes:

1. To Analyse and describe the effects of humans on the environment.
2. To Apply knowledge, ideas and techniques from several disciplines to environmental issues.
3. To The ability to analyse, assess and manage public health concern at the state and central levels.

Suggested Readings:

1. Dash MC and Mishra PC, Man and Environment, McMillan, London
2. Mishra PC and Das MC, Environment and Society, McMillan, London
3. Odum EP, Fundamentals of Ecology, Natraj Publication
4. Mishra DD, Fundamental Concept in Environmental Studies, S. Chand, New Delhi
5. Asthana DK and Asthana Meera, A Textbook of Environmental Studies, S. Chand, New Delhi
6. Bharucha Erach, Textbook for Environmental Studies, Universities Press India Pvt. Ltd., Hyderabad

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- VI)

Course Code : MRT/DSE/612-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Environment & Disaster Management**	

Learning Objective :

1. Gain knowledge on Environment, its structure, climate change, sustainable development, disaster management, different type of diseases and public health management.
2. Learner lay foundation on the concept of disaster management, vulnerability, assessment and risk analysis, institutional framework, preparedness measures and survival skills.
3. The learner develop understanding on the Environment, ecosystem, biogeochemical cycle, environmental pollution and capability to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.

Unit	Course Content	Periods
I	1) To Study of Environment 2) To Study of Ecosystem and Biogeochemical Cycle 3) To Study of Environmental Pollution.	06
II	4) To Study of Environmental Laws 5) To Study of Climate Change and Sustainable Development 6) To Study of Population Ecology	06
III	7) To Study of Population Growth and Controls 8) To Study of Disaster Management 9) To Study of Vulnerability Assessment and Risk Analysis.	06
IV	10) To Study of Institutional Framework 11) To Study of Preparedness Measures and Survival Skills 12) To Study of Public Health Management	06

V	13) To Study of Brief Idea on Epidemic & Pandemic and its prevention 14) To Study of Life Style Management 15) To Study of Role of Different Sector in Managing Health Disaster	06

Learning Outcomes:

1. To Analyse and describe the effects of humans on the environment.
2. To Apply knowledge, ideas and techniques from several disciplines to environmental issues.
3. To The ability to analyse, assess and manage public health concern at the state and central levels.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(RESARCH PROJECT - I)

Course Code No.: MRT/RP-I/613-T	No. of Credits: 04	Hours: 60
Course Title:	Research Project - I	Hours : 08 Hrs./Week

Learning Objectives

1. Student will know the different research approaches, scientific methods, criteria for good research and innovation.
2. Student will get knowledge of problems encountered while working on research plan, Field and laboratory research problems.
3. Students can design the research project with the help of review of produced results, techniques of interpretation, published literature and proper layout of research report

Unit	Course Content
I	1) Evaluation of Plant-Insect Interactions in Agro ecosystems: Implications for Pest Management. 2) Investigating the Role of Keystone Species in Maintaining Ecosystem Stability. 3) Characterization of Proximate analysis in substrate: Potential for Biogas.
II	4) Analysis of Rural Technology and Habitat Preferences in Urban vs. Rural Landscapes. 5) Comparative Study of Traditional vs. Molecular Taxonomic Approaches in Species Identification. 6) Assessment of Genetic Variation in Wild and Cultivated Populations of Medicinal Plants.
III	7) Mapping Wetland Ecosystems and Assessing Their Contribution to Biodiversity Conservation. 8) Exploring the Issues of rural technology on Wildlife Corridors and Connectivity. 9) Evaluation of Remote Sensing Techniques for Monitoring Coral Reef Health
IV	10) Investigating the Effects of Land Use Change on Soil Microbial Community Composition. 11) Assessment of Genetic Diversity & Population Structure of Amphibians in Fragmented Habitats. 12) Assessment of comparison between primary and secondary nutrient.

V	13) Investigating the Role of Microbial Communities in Soil Nutrient Cycling and Productivity. 14) Assessing the Impacts of Invasive Plant Species on Native Flora and Fauna. 15) Exploring the Relationship Between evaporation and transpiration.

Learning Outcomes

1. Explain the different research approaches, scientific methods, criteria for good researches.
2. Design the research project with the help of review of produced research, techniques of interpretation, published literature and proper layout of research.
3. Acquire knowledge of data collection, presentation of data, data analysis and interpretations.

Note: Any other areas relevant to the concerned subject

These additional project ideas cover various aspects of rural technology, ecosystem dynamics, and the application of biotechnological and phylogenetic approaches in understanding and managing natural systems. Students can select or modify these topics based on the interest, available resources and research objectives. "Students are encouraged to propose their own project topics within the course's scope, focusing on rural technology, taxonomy, remote sensing, solar energy wind power botany horticulture floriculture food technology and etc. Projects should align with personal interests and contribute to understanding rural technology efforts. Approval from the Subject Teacher is required for project selection."

17. Curriculum for Semester - IV

AS PER NEP 2020

Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: IV Subject: Rural Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory – DSC	MRT/MJ/650-T	Agricultural Biotechnology	2		2		12
	MRT/MJ/651-T	Biomass Management & Utilization	2		2		
	MRT/MJ/652-T	Apiculture	2		2		
	MRT/MJ/653-P	Lab-I: Agricultural Biotechnology		4		2	
	MRT/MJ/654-P	Lab-II: Biomass Management & Utilization		4		2	
	MRT/MJ/655-P	Lab-III: Apiculture		4		2	
DSE (Choose any one from pool of courses)	MRT/DSE/656-T	Farm Machine and Power	2		2		04
	MRT/DSE/657-P	Lab-IV: Farm Machine and Power		4		2	
	or	or					
	MRT/DSE/658-T	Power System for Renewable Energy Sources	2		2		
	MRT/DSE/659-P	Lab-IV: Power System for Renewable Energy Sources		4		2	
	or	or					
	MRT/DSE/660-T	Mushroom Cultivation Techniques	2		2		
	MRT/DSE/661-P	Lab-IV: Mushroom Cultivation Techniques		4		2	
RP-2	MRT/RP-II/662-P	Research Project-II		6		6	06
			08	22	08	14	22 Credits

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- I)

Course Code No.: MRT/MJ/650-T	No. of Credits: 02	Hours: 30
Course Title	**Agricultural Biotechnology**	

Learning Objectives:

1. To understand the principles and the emerging concepts in agricultural biotechnology.
2. To critically evaluate the application of plant and microbial biotechnologies for sustainable agriculture.
3. To discuss and analyse how modern agricultural biotechnology and genetic resources can be harnessed to achieve environmental sustainability.

Unit	Course Content	Periods
I	General Aspects; Novel features of plant growth and development; Concept of plasticity in plant development; Analyzing plant growth; Seed Germination and Seedling Growth; Mobilization of food reserves during seed germination; Tropisms; Hormonal control of seed germination and seedling growth. Floral Induction and Development; Photoperiodism and its significance; Vernalization and hormonal control; Inflorescence and floral determination; Molecular genetics of floral development and floral organ differentiation; Sex determination.	06
II	Carbon Assimilation; Light absorption and energy conversion; Calvin Cycle; Hatch- Slack pathway; Reductive pentose phospha tem pathway; Carbon dioxide uptake and assimilation; Photorespiration; Glycolate metabolism. Molecular biology of photosynthetic processes Nitrogen Fixation -- Symbiotic and non-symbiotic nitrogen fixation; Role of lectins; nod genes; nif genes; Structure, function and regulation of nitrogenase; Leghaemoglob in; Nodulins; Molecular aspects of regulation and enhancement of nitrogen fixation. Mycorrhizal-plant symbiosis.	06
III	History of plant cell and tissue culture, Culture media; Various types of cultures: callus, cell suspension, nurse, root, meristem, In Vitro differentiation: Organogenesis and somatic embryogenesis; Molecular basis of plant organ differentiation Micro-propagation – plant multiplication, hardening, transplantation, genetic fidelity, scale up and cost reduction, bioreactor, artificial seeds; Applications of tissue culture: Virus elimination by shoot tip culture;	06

IV	Large-scale production of alkaloids and other secondary metabolites through cell culture techniques; high yielding cell lines, factors effecting production, Biotransformation, elicitors induced production, Hairy root culture and production of secondary metabolites. Immobilization of plant cells. Plant Genetic resources, Germplasm conservation and cryopreservation, cryoprotectants, Gene bank, Some case studies on success stories on commercial application of plant tissue culture.	06
V	Conventional methods for crop improvement: Principles of plant breeding, Breeding methods for self and cross pollinated crops, Heterosis breeding, Mutation breeding, Limitations of conventional breeding Plant Genome – Nuclear and cytoplasmic; Significance of organelle genomes; Genome size and sequence components; Modern gene concept - Gene structure, structural and functional genes. Molecular markers: Definition, properties, kinds of molecular markers: – Restriction based and PCR based; RFLP: methodology and applications, RAPD & AFLP: Principles, methodology and applications, Development of SCAR and SSR markers. Other markers: CAPS, SNP, Comparison of different marker systems.	06

Learning Outcomes

1. Agricultural Biotechnology graduates will acquire knowledge about the range of approaches to manipulate and improve plants, animals and microorganisms.
2. Agricultural Biotechnology graduates will demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation.
3. Agricultural Biotechnology graduates will understand the relationship between society and science and the justification for biotechnological manipulation of plants, animals, and microorganisms.

Suggested Readings:

1) "Plant Biotechnology and Genetics: Principles, Techniques and Applications" by C Neal Stewart Jr.
2) "Applied Biotechnology And Plant Genetics" By M Sudhir
3) Advances In Applied Bioremediation (Soil Biology)" By Ajay Singh And Ramesh ChanderKuhad
4) "Plant Biotechnology: Current and Future Applications of Genetically Modified Crops" By Nigel Halford.
5) "Applied Biotechnology And Plant Genetics" By Ashok Gangul

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- II)

Course Code No.: MRT/MJ/651-T	No. of Credits: 02	Hours: 30
Course Title	**Biomass Management & Utilization**	

Learning Objectives:

1. To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions.
2. To produce graduates strong in energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.
3. To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable energy management

Unit	Course Content	Periods
I	**Introduction** 1.1 Biomass as energy source; Biomass availability in North Eastern States of India 1.2 Production of biomass, Photosynthesis, efficiency of C3 & C4 plants on biomass production. 1.3 Classification of biomass.	06
II	**Biomass as fuel** 2.1 Physicochemical characteristics of biomass as fuel 2.2 Thermal characteristics of biomass as fuel 2.3 Biomass conversion routes: biochemical, chemical and thermo-chemical	06
III	**Biochemical conversion of biomass for energy production** 3.1 Anaerobic digestion, biogas production mechanism 3.2 Types of digesters, installation, operation and maintenance of biogas plants 3.3 Biogas plants manure-utilization and manure values. 3.4 Biogas utilization and storage 3.5 Biogas for motive power generation etc.	06

IV	**Liquid biofuel** 4.1 Biodiesel – the mechanism of transesterification, fuel characteristics of biodiesel, technical aspects of biodiesel engine utilization 4.2 Alcohol production from biomass- types of materials of alcohol production-process description, utilization	06
V	**Chemical conversion of biomass for energy production** 5.1 Chemical conversion processes 5.2 Hydrolysis and hydrogenation	06

Learning Outcomes

1. Students will understood and acquired fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies.
2. Students will acquire the expertise and skills needed for the energy monitoring, auditing and management, and for the development, implementation, and maintenance and auditing of Energy Management Systems.
3. Will become capable of analysis and design of energy conversion systems.

Suggested Readings:

1. Mukunda HS. Understanding Clean Energy and fuels from biomass, Wiley-India Pvt. Ltd, 2011
2. Pandey A. Hand book of plant based bio-fuel CRC Press, Taylor & Francis, 2008
3. Mital KM. Biogas Systems, Principle and Applications. New Age International Ltd. 1996
4. Rai GD. Non-conventional energy sources. Khanna Publication, 2001
5. Ravindranath NH. Hall DO. Biomass, Energy and Environment, A developing Country perspective from India. Oxford University Press, 19

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- III)

Course Code No.: MRT/MJ/652-T	No. of Credits: 02	Hours: 30
Course Title:	**Apiculture**	

Learning Objectives

1. This course is generally a stand-alone course, but to some degree relies on the students'
2. knowledge gained from previous courses especially Introductory entomology, Biochemistry and general Physiology
3. To prepare the students for successful career in the Apiculture and its management agencies.

Unit	Course Content	Periods
I	**Introduction of Modern bee keeping** 1.1. Importance of beekeeping, Potential of beekeeping in Maharashtra and India 1.2. Taxonomy, diversity of bee species 1.2.1Taxonomic position, diversity, habit, habitat and nesting behaviour of honey bees 1.3. Colony organization and life cycle of honey bee 1.3.1.. Cast differentiation, Colony organization (Social organization) and Division of labour in honeybee 1.3.2. Life cycle of honeybee and nuptial flight	06
II	**Obtaining and installing of bee colony** 2.1. Purchasing established colony, Methods of Swarm capturing, 2.2. Hiving by dividing an established colony –making two hives from one, making one hive from two 2.3. Handling of the bee colony 2.4. Location and establishment of apiary	06
III	**Scientific beekeeping** 3.1. Basic Beekeeping equipment's for beekeepers 3.2. Commercial bee keeping 3.3. Seasonal management of apiary and basic inspection techniques of bee colonies. 3.4. Problems of beekeeping industries, Natural climate condition, Natural enemies and bee pest, Human Activities, Pesticide bee poisoning. 3.4.1. Bee diseases and remedies, Brood diseases, Adult bee diseases.	06

	3.4.2. Apiary and Hive Hygiene	
IV	**Apiculture in Agriculture** 4.1. Bee plants and floral calendar- Importance and qualities of good bee flora. 4.2. Pollination, 4.2.1. Role of honey bees in pollination of agricultural crops and its benefits 4.5.2. Management of honeybees for improved pollination. 4.5.1. Foraging strength and requirement of honeybee colonies, and their distribution in the crop. 4.5.3. Pollination in green house cages. 4.6. Constraints in the development of beekeeping on agricultural belts 4.6. Improvement of bee forage. 4.8. Migratory beekeeping	06
V	**Honeybee products for health** 5.1. Honey- Its constituents, methods of collection and uses. 5.2. Importance of other bee products to mankind a) Pollen –Method of collection, constituents, uses. b) Royal jelly- Method of collection, constituents, uses. c) Propolis - Method of collection, constituents, uses. d) Bee wax- Method of collection, constituents, uses. e) Bee venom- Method of collection, constituents, uses. f) Beethearpy	06

Learning Outcomes:

1. Describe the importance, biology and management of bees.
2. Demonstrate bee keeping management skills
3. Apply the knowledge on bee biology and management to the development of the bee industry in tropical environments.

Suggested Readings

1. Introduction to disease of bee –Bailey, L
2. World of honeybee –Butter C. G.
3. Beekeeping in India –Sardar Sing (ICAR)
4. The Principle of Insect Physiology-Wigglesworth, V.S.
5. Applied Zoology Dr. B. B. Waykar, (Prashant Publication Jalgaon)

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- IV)

Course Code No.: MRT/MJ/653-P	No. of Credits: 02	Hours: 30
Course Title	Lab-I: Agricultural Biotechnology	

Learning Objectives:

1. To understand the principles and the emerging concepts in agricultural biotechnology.
2. To critically evaluate the application of plant and microbial biotechnologies for sustainable agriculture.
3. To discuss and analyse how modern agricultural biotechnology and genetic resources can be harnessed to achieve environmental sustainability.

Unit	Course Content	Periods
I	1) To Study of Plant DNA extraction, digestion of DNA with restriction enzymes, agarose gel electrophoresis 2) To Study of Polymerase chain reaction to amplify a plant gene. 3) To Study of Homogenization of leaves,	06
II	4) To Study of sub-cellular fractionation by differential centrifugation. 5) To Study of chloroplast purification 6) To Study of SDS-PAGE analysis of chloroplast proteins	06
III	7) To Study of RNA extraction 8) To Study of Agarose gel electrophoresis of RNA 9) To Study of RT-PCR analysis of a plant gene	06
IV	10) To Study of Preparation of Murashige and Skoog medium. 11) To Study of stocks of macronutrients, micronutrients, vitamins and hormones, autoclaving, filter sterilization of hormones and antibiotics 12) To Study of Surface-sterilization of seeds, establishment of axenic plants, acclimatization of tissue culture plants and establishment in greenhouse.	06

V	13) To Study of Callus induction in tobacco leaf discs, regeneration of shoots, root induction. 14) To Study of role of hormones in morphogenesis 15) To Study Protoplast isolation viability test and culture	06

Learning Outcomes

1. Agricultural Biotechnology graduates will acquire knowledge about the range of approaches to manipulate and improve plants, animals and microorganisms.
2. Agricultural Biotechnology graduates will demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation.
3. Agricultural Biotechnology graduates will understand the relationship between society and science and the justification for biotechnological manipulation of plants, animals, and microorganisms.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- V)

Course Code No.: MRT/MJ/654-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-II: Biomass Management & Utilization**	

Learning Objectives

1. To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions.
2. To produce graduates strong in energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.
3. To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable energy management.

Unit	Course Content	Periods
I	1) To Study of Biomass as fuel 2) To Study of Physicochemical characteristics of biomass as fuel 3) To Study of Thermal characteristics of biomass as fuel	06
II	4) To Study of Biomass conversion routes 5) To Study of Anaerobic digestion 6) To Study of biogas production mechanism	06
III	7) To Study of Types of digesters, 8) To Study of maintenance of biogas plants 9) To Study of Biogas utilization and storage	06
IV	10) To Study of Biogas for motive power generation etc. 11) To Study of Biodiesel 12) To Study of Alcohol production from biomass	06
V	13) To Study of Chemical conversion of biomass for energy production 14) To Study of Synthesis biofuel 15) To Study of Thermo chemical conversion of biomass.	06

Learning Outcomes

1. Students will understood and acquired fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies.
2. Students will acquire the expertise and skills needed for the energy monitoring, auditing and management, and for the development, implementation, and maintenance and auditing of Energy Management Systems.
3. Will become capable of analysis and design of energy conversion systems.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(MANDATORY SUBJECT- VI)

Course Code No.: MRT/MJ/655-P	No. of Credits: 02	Hours: 30
Course Title:	Lab-III: Apiculture	

Learning Objectives

1. This course is generally a stand-alone course, but to some degree relies on the students'
2. knowledge gained from previous courses especially Introductory entomology, Biochemistry and general Physiology
3. To prepare the students for successful career in the Apiculture and it's management agencies.

Unit	Course Content	Periods
I	1) To study of external morphology of honeybee 2) To study of Indian species of honeybee. 3) To study of life cycle of honeybee	06
II	4) To study of architecture of honey comb 5) To study of tourism & sustainable development. 6) To study of diseases, of the honeybee	06
III	7) To study of pests, of the honeybee. 8) To study of, parasites of the honeybee. 9) To study of predators of the honeybee.	06
IV	10) To study of bee keeping equipment's and their uses. 11) To study of artificial bee breeding technique. 12) To study of Preparation of floral colander of bee plants in area.	06
V	13) To study of methods of collection and preservation of honey, wax, pollen, pro-polish, Royal jelly and bee venom, 14) To study of Maintenance of honeybee colony. 15) To study of Practical experience (Compulsory Rearing of live in rural areas.	06

Learning Outcomes:

1. Describe the importance, biology and management of bees.
2. Demonstrate bee keeping management skills
3. Apply the knowledge on bee biology and management to the development of the bee industry in tropical environments.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- I)

Course Code: No: MRT/DSE/656-T	No. of Credits: 02	Hours: 30
Course Title:	**Farm Machine and Power**	

Learning Objectives

1. To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions.
2. To produce graduates strong in energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.
3. To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable energy management.

Unit	Course Content	Periods
I	Introduction to renewable energy grid integration, concept of mini/micro grids, and smart grids. Review of synchronous generators, Introduction to power system stability problems: rotor angle stability, voltage stability and voltage collapse, classification of stability. Modeling of synchronous machines: transformations, synchronous machine representation in stability studies	06
II	Small Hydropower Systems - Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection and civil works	06
III	Introduction to induction machines: electrical characteristics, slip, seed-torque characteristics etc. Self-excited induction generator, Constant speed Induction generators, Variable speed Induction generators, doubly fed Induction generators	06
IV	Introduction to power electronic devices, AC/DC converters, PWM, THD. Permanent magnet synchronous generator, solar PV systems, fuel cell, aquaelectrolizer	06
V	Issues in integration of synchronous generator based, induction generator based and converter based sources together. Network voltage management (discusses the issue of voltage levels).	06

Learning Outcomes

1. List and generally explain the main sources of energy and their primary applications in the US, and the world.
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
3. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.

Suggested Readings:

1. Brendan Fox et. al.: Wind Power Integration connection and system operational aspects, IET Power and Energy Series 50 (2007).

2. Marco H. Balderas (ed.): Renewable Energy Grid Integration, (Nova Science Publishers, New York, 2009)

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- II)

Course Code No.: MRT/DSE/657-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Farm Machine and Power**	

Learning Objectives

1. To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions.
2. To produce graduates strong in energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.
3. To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable energy management

Unit	Course Content	Periods
I	1) To Study of renewable energy grid integration 2) To Study of review of synchronous generators 3) To Study of power system stability problems	06
II	4) To Study of rotor angle stability 5) To Study of voltage stability and voltage collapse 6) To Study of Modelling of synchronous machines	06
III	7) To Study of Small Hydropower Systems 8) To Study of induction machines 9) To Study of electrical characteristics	06
IV	10) To Study of power electronic devices 11) To Study of AC/DC converter 12) To Study of permanent magnet synchronous generator	06
V	13) To Study of solar PV systems 14) To Study of aquaelectrolizer 15) To Study of Issues in integration of synchronous generator based	06

Learning Outcomes

1. List and generally explain the main sources of energy and their primary applications in the US, and the world.
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
3. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- III)

Course Code No.: MRT/DSE/658-T	No. of Credits: 02	Hours: 30
Course Title:	**Power System for Renewable Energy Sources**	

Learning Objectives

1. To understand different use of Medicinal Plants
2. To be able to interpret Medicinal plant conservation – issues and approaches.
3. To understand land use impact of Taxonomic descriptions and uses of important aromatic plants

Unit	Course Content	Periods
I	MAPs: definition, history, importance and future prospects. Medicinal Plants – past and present status in world and India. MAPs as industrial crops - constraints and remedial measures. Medicinal plant diversity & local healthcare. Medicinal plant conservation – issues and approaches. Medicinal plant conservation areas (MPCA), Non-timber forest products (NTFP), Good Agriculture Practices (GAP). Indian Himalayan region (IHR).	06
II	Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. Other organizational initiatives for promotion of MAPs at National and International levels. Demand and supply of medicinal plants. Herbal industries.	06
III	Important medicinal plants of India with their systematics, geographical distribution and uses. Acorus calamus, Adhatoda vasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona.	06
IV	Important aromatic plants of India with their systematics, geographical distribution and uses. Introduction and historical background of aromatic plants. Aromatic and cosmetic products. Raw material for perfumes etc. Cosmetic Industries. Major, minor and less known aromatic plants of India	06

V	Taxonomic descriptions and uses of important aromatic plants – citronella, davana, damask rose, geranium, khus grass, large cardamom, lavender, lemon grass, mentha, holy basil, patchouli, rosemary Palmarosa, vetiver, artemisia, eucalyptus, thyme, marjoram and oreganum. Aromatic spices - clove, cinnamon, nutmeg, dill, celery, tamarind, garcinia, curry leaf and saffron.	06

Learning Outcomes

1. Suggest use of Medicinal Plants
2. Assess the current status of the Medicinal and Aromatic Plants at field, by taking up accurate investigation measures and conduct survey
3. Suggest Medicinal and Aromatic Plants in drought area.

Suggested Readings

1. Medicinal Plants of Uttarakhand by C.P. Kala (2010)
2. Indian Medicinal Plants by P.C. Trivedi (2009).
3. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
4. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
5. Handbook of MAPs by S.K. Bhattacharjee (2009).

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL

DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- IV)

Course Code No.: MRT/DSE/659-P	No. of Credits: 02	Hours: 30
Course Title:	Lab-IV - Power System for Renewable Energy Sources	

Learning Objectives

1. To understand different use of Medicinal Plants
2. To be able to interpret Medicinal plant conservation – issues and approaches.
3. To understand land use impact of Taxonomic descriptions and uses of important aromatic plants

Unit	Course Content	Periods
I	1) To Study of MAPs: definition, history, importance and future prospects. 2) To Study of Medicinal Plants – past and present status in world and India. 3) To Study of MAPs as industrial crops - constraints and remedial measures.	06
II	4) To Study of Medicinal plant diversity & local healthcare. 5) To Study of Medicinal plant conservation – issues and approaches 6) To Study of Medicinal plant conservation areas (MPCA)	06
III	7) To Study of Non-timber forest products (NTFP) 8) To Study of Good Agriculture Practices (GAP) 9) To Study of Promotion of medicinal plant sector at national level	06
IV	10) To Study of national Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. 11) To Study of Demand and supply of medicinal plants. 12) To Study of Herbal industries.	06
V	13) To Study of Important medicinal plants of India with their systematics, geographical distribution and uses. 14) To Study of Acorus calamus, Adhatoda vasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona 15) To Study of Aromatic spices - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curryleaf and saffron.	06

Learning Outcomes

1. Suggest use of Medicinal Plants
2. Assess the current status of the Medicinal and Aromatic Plants at field, by taking up accurate investigation measures and conduct survey
3. Suggest Medicinal and Aromatic Plants in drought area.

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- V)

Course Code No.: MRT/DSE/660-T	No. of Credits: 02	Hours: 30
Course Title:	Mushroom Cultivation Techniques	

Learning Objective :

1. Enable the students to identify edible and poisonous mushrooms
2. Provide hands on training for the preparation of bed for mushroom cultivation and spawn production
3. Give the students exposure to the experiences of experts and functioning mushroom farms.

Unit	Course Content	Periods
I	**Introduction to mushrooms** Mushrooms -Taxonomical rank -History and Scope of mushroom cultivation - Edible and Poisonous Mushrooms-Vegetative characters	06
II	**Common edible mushrooms** Button mushroom (Agaricus bisporus), Milky mushroom (Calocybe indica), Oyster mushroom (Pleurotus sajorcaju) and paddy straw mushroom (Volvariella volvcea).	06
III	**Principles of mushroom cultivation** Structure and construction of mushroom house. Sterilization of substrates. Spawn production - culture media preparation- production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation. Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom. Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies.	06
IV	**Health benefits of mushrooms** Nutritional and medicinal values of mushrooms. Therapeutic aspects- antitumor effect	06
V	**Post-harvest technology** Preservation of mushrooms - freezing, dry freezing, drying, canning, quality assurance and entrepreneurship. Value added products of mushrooms.	06

Learning Outcomes:

1. Identify edible types of mushroom
2. Gain the knowledge of cultivation of different types of edible mushrooms and spawn production
3. Manage the diseases and pests of mushrooms

Suggested Readings:

1. 1. Marimuthu, T. et al. (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
2. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
3. Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
4. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
5. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
6. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
7. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi (2000)

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

(ELECTIVE SUBJECT- VI)

Course Code : MRT/DSE/661-P	No. of Credits: 02	Hours: 30
Course Title:	**Lab-IV - Mushroom Cultivation Techniques**	

Learning Objective :

1. Enable the students to identify edible and poisonous mushrooms
2. Provide hands on training for the preparation of bed for mushroom cultivation and spawn production
3. Give the students exposure to the experiences of experts and functioning mushroom farms.

Unit	Course Content	Periods
I	1) To Study of Sterilization of mushroom house 2) To Study of Sanitation of mushroom house 3) To Study of instruments and substrates of mushroom house.	06
II	4) To Study of Preparation of mother culture 5) To Study of Media preparation 6) To Study of Inoculation	06
III	7) To Study of incubation and spawn production Cultivation of oyster mushroom using paddy straw. 8) To Study of Incubation and spawn production Cultivation of oyster mushroom using agricultural wastes 9) To Study of Preservation of mushrooms.	06
IV	10) To Study of Nutritional and medicinal values of mushrooms 11) To Study of Therapeutic aspects- antitumor effect 12) To Study of Button mushroom (Agaricus bisporus)	06
V	13) To Study of Milky mushroom (Calocybe indica) 14) To Study of Oyster mushroom (Pleurotus sajorcaju) 15) To Study of Paddy straw mushroom (Volvariella volvcea).	06

Learning Outcomes:

1. Identify edible types of mushroom
2. Gain the knowledge of cultivation of different types of edible mushrooms and spawn production.
3. Manage the diseases and pests of mushrooms

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(RESARCH PROJECT - II)

Course Code No.: MRT/RP-II/662-P	No. of Credits: 06	Hours: 90
Course Title:	**Research Project - II**	**Hours : 12 Hrs./Week**

Learning Objectives

1. Student will know the different research approaches, scientific methods, criteria for good research and innovation.
2. Student will get knowledge of problems encountered while working on research plan, Field and laboratory research problems.
3. Students can design the research project with the help of review of produced results, techniques of interpretation, published literature and proper layout of research report

Unit	Course Content
I	1) Evaluation of Plant-Insect Interactions in Agro ecosystems: Implications for Pest Management. 2) Investigating the Role of Keystone Species in Maintaining Ecosystem Stability. 3) Characterization of Proximate analysis in substrate: Potential for Biogas.
II	4) Analysis of Rural Technology and Habitat Preferences in Urban vs. Rural Landscapes. 5) Comparative Study of Traditional vs. Molecular Taxonomic Approaches in Species Identification. 6) Assessment of Genetic Variation in Wild and Cultivated Populations of Medicinal Plants.
III	7) Mapping Wetland Ecosystems and Assessing Their Contribution to Biodiversity Conservation. 8) Exploring the Issues of rural technology on Wildlife Corridors and Connectivity. 9) Evaluation of Remote Sensing Techniques for Monitoring Coral Reef Health
IV	10) Investigating the Effects of Land Use Change on Soil Microbial Community Composition. 11) Assessment of Genetic Diversity & Population Structure of Amphibians in Fragmented Habitats. 12) Assessment of comparison between primary and secondary nutrient.

V	13) Investigating the Role of Microbial Communities in Soil Nutrient Cycling and Productivity. 14) Assessing the Impacts of Invasive Plant Species on Native Flora and Fauna. 15) Exploring the Relationship Between evaporation and transpiration.

Learning Outcomes

1. Explain the different research approaches, scientific methods, criteria for good researches.
2. Design the research project with the help of review of produced research, techniques of interpretation, published literature and proper layout of research.
3. Acquire knowledge of data collection, presentation of data, data analysis and interpretations.

Note: Any other areas relevant to the concerned subject

These additional project ideas cover various aspects of rural technology, ecosystem dynamics, and the application of biotechnological and phylogenetic approaches in understanding and managing natural systems. Students can select or modify these topics based on the interest, available resources and research objectives. "Students are encouraged to propose their own project topics within the course's scope, focusing on rural technology, taxonomy, remote sensing, solar energy wind power botany horticulture floriculture food technology and etc. Projects should align with personal interests and contribute to understanding rural technology efforts. Approval from the Subject Teacher is required for project selection."