



**DR. BABASAHEB AMBEDKAR
MARATHWADA UNIVERSITY,
AURANGABAD-431004 (M.S.)
GOPINATHRAO MUNDE NATIONAL
INSTITUTE OF RURAL DEVELOPMENT &
RESEARCH**



DETAILED SCHEME OF SUBJECTS CREDITS WORKLOAD AND EVALUATION .

FOR

**MASTER OF RURALSTUDIES- (MRS)
(Rural Technology)
(Two Year-Four Semester Program)**

(Effective from Academic year 2018-2019 & Onwards)

1. MASTER OF RURAL STUDIES IN RURAL TECHNOLOGY

2. YEAR OF IMPLEMENTATION: Under the Gopinathrao Munde National Institute of Rural Development & Research (GMNIRD) a new syllabus for Master in Rural Studies in Master of Rural Studies in Rural Technology is to be implemented from the academic year 2018-19 onwards in Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

3. 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.

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 multi-disciplinary Institute covering all disciplines of science, technology, social sciences, agricultural sciences, trade and managerial subjects.

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/agripreneurship/Coopreneurship with special focus on the most Socio-economically backward and drought regions.

5. INTAKE

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

6. DURATION

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

7. ELIGIBILITY:

- i) 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.

ii) He/ She should have passed the Entrance Test conducted by the University with the specified criteria.

8. PATTERN:

The pattern of examination will be Semester with Credit and Continuous Internal Evaluation [CIE].

9. MEDIUM OF INSTRUCTION:

The medium of instruction shall be in English..

10. 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 state govt. in particular.
3. It is innovative, skill and employment oriented to attract bright students to the discipline of rural development.

11. COURSE STRUCTURE

Total Marks for PG Programme will be 2650.

Total Credits will be : 106

Faculty of Multidisciplinary Studies
MASTER OF RURAL STUDIES (M.R0S)
DEPARTMENT OF RURAL TECHNOLOGY
Scheme of M. R.S.
Rural Technology

Semester – I												
Subject Code No.	Subjects	Contact Hrs/ Week				Examination Scheme					Credits	Duration of Theory Exam
		L		P	Tot al	CT	TA	PR	ESE	Grand Total		
COI-110	Constitution of India	2		-	2	20		-	30	50	2	2 Hrs
RTB--111	Natural Rural Resources : Assessment & Management	4			4	40		-	60	100	4	2 Hr. 30 Min.
RTR--112	Research Methodology	4			4	40		-	60	100	4	2 Hr. 30 Min.
RTC--113	Crop Production Technology	4			4	40		-	60	100	4	2 Hr. 30 Min.
RTC—114	Irrigation Techniques	4			4	40		-	60	100	4	2 Hr. 30 Min.
RTB -115	Lab I- Natural Rural Resources : Assessment & Management			4	4		25	25		50	2	4 hrs
RTR- 116	Lab II – Research Methodology			4	4		25	25		50	2	4 hrs
RTC -117	Lab III - Crop Production			4	4		25	25		50	2	4 hrs
RTC -118	Lab IV - Irrigation Techniques			4	4		25	25		50	2	4 hrs
Total of Semester-I		18		16	34	180	100	100	270	650	26	

Semester – II

Subject Code No.	Subjects	Contact Hrs/ Week				Examination Scheme					Credits	Duration of
		L	T	P	Tot	CT	TA	PR	ESE	Grand Total		
RTC -121	Food Processing Technology-I	4		-	4	40		-	60	100	4	2 Hr. 30 Min.
RTC-122	Watershed Management-I	4			4	40		-	60	100	4	2 Hr. 30 Min.
RTC-123	Animal Husbandry	4			4	40		-	60	100	4	2 Hr. 30 Min.
*RTE-124A	Climate Change & Conservation of Biodiversity	4			4	40		-	60	100	4	2 Hr. 30 Min.
*RTE - 124B	Greenhouse Technology											
RTC -125	Lab I- Food Processing			4	4		25	25		50	2	4 hrs
RTC -126	Lab II – Watershed Management-I			4	4		25	25		50	2	4 hrs
RTC -127	Lab III - Animal Husbandry			4	4		25	25		50	2	4 hrs
*RTE -128A	Lab IV - Biodiversity			4	4		25	25		50	2	4 hrs
*RTE -128B	Lab IV – Greenhouse Technology											
	Total of Semester-II	16	-	16	32	160	100	100	240	600	24	
	Grand Total of Semester I & II									1250	50	

* **Note:** Students have to opt any one of the electives from RTE-124A and RTE-124B.

Semester-III

Course Code	Subjects	Contact Hrs./ Week			Total	Examination Scheme					Credits	Duration of Examination
		L	T	P		TA	CT	PR	ESE	Grand Total		
RTC-231	Food Processing Technology-II	4			4	-	40	-	60	100	4	2 Hr. 30 Min.
RTC-232	Watershed Management-II	4		-	4	-	40	-	60	100	4	2 Hr. 30 Min.
RTC-233	ICT in Rural Technology	3	1		4	-	40	-	60	100	4	2 Hr. 30 Min.
*RTE-234 A	Organic Farming	4			4	-	40	-	60	100	4	2 Hr. 30 Min.
*RTE-234 B	Rural tourism											
RTC-235	Lab I- Food Processing Technology-II			4	4	25		25		50	2	4 hrs
RTC-236	Lab II – Watershed Management-II			4	4	25		25		50	2	4 hrs
*RTE-237 A	Lab III - Organic Farming			4	4	25		25		50	2	
RTE-237 B	Lab III - Rural Tourism											
RTP-238	Project-I /Field survey/Work			4	4	25		25		50	2	4 hrs
Service course												
RTS-239	Green House Technology	3	1		4	-	40	-	60	100	4	3 Hrs
Total of Semester-III		18	2	16	36	100	200	100	300	700	28	

* **Note** :Students have to opt any one of the electives from RTE-234A and RTE-234B.

** Students have to opt any one of the service courses (viz. RSS-239, / CBS-239 / RES-239). These courses will be conducted by the respective departments viz. 1. Rural Development & Research (Socio-Cultural and Political) 2. Conservation of Bio-diversity, 3. Rural Economic, Banking & Industry.

Semester-IV

Course Code	Subjects	Contact Hrs./ Week			Total	Examination Scheme					Credits	Duration of Examination
		L	T	P		TA	CT	PR	ESE	Grand Total		
RTC-241	Agricultural Biotechnology	4			4	-	40	-	60	100	4	2 Hr. 30 Min.
RTC-242	Biomass Management & Utilization	4		-	4	-	40	-	60	100	4	2 Hr. 30 Min.
*RTE-243A	Power Systems For Renewable Energy Sources	4			4	-	40	-	60	100	4	2 Hr. 30 Min.
*RTE-243B	Apiculture											
RTC-244	Lab-I Agricultural Biotechnology			4	4	25		25		50	2	4 hrs
RTC-245	Lab-II Biomass Management & Utilization			4	4	25		25		50	2	4 hrs
RTE-246A	Lab-III Power Systems For Renewable Energy Sources			4	4	25		25		50	2	4 hrs
RTE-246B	Lab-III Apiculture											
RTT-247	Implant Training / Report and Seminar**					50		50		100	4	4 hrs
RTP-248	Project -II (Dissertation/Report, Seminar)			12	12	75		75		150	6	4 hrs
	Total of Semester- III	12		24	36	200	120	200	180	700	28	
	Grand Total of Semester III & IV									1400	56	
	Grand Total of Semester I,II, III & IV									2650	106	

Note: *Students of Rural Technology have to opt any one of the electives from RTE-243A and RTE-243B.

** Minimum Two Months Implant Training.

Periods

L: Lecture hours per week

P: Practical hours per week

Class Test Duration: 1 hour

Abbreviations:

COI Constitution of India

RTB: Rural Technology Bridge Course

RTR Rural Technology Research

RTC: Methodology

Rural Technology Core Course

RTE Rural Technology Elective Course

RTS: Rural Technology Service Course

RTT Rural Technology Training Course

RTP: Rural Technology Project work

Evaluation Scheme

TA: Teachers Assessment

CT: Class Test

PR: Practical

TOT: Total for sessional exam of evaluation scheme

ESE: End Semester Examination

Note: **The minimum two month implant training is compulsory for the students in order to complete the degree program. The students can undertake the implant training from I semester onwards during the winter/summer vacation and will be assessed at semester end practical examination (IV Sem).

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT & RESEARCH

Course Code No.: COI- 110	No. of Credits: 02	Hours: 30
Course Title:	CONSTITUTION OF INDIA	
Teaching Objectives :-		
<ol style="list-style-type: none"> 1. To know the history and composition of the Indian constitution. 2. To study the preamble of the constitution. 3. To study the constitutional Rights and duties of the citizen. 4. To study the organ of Governance. 		
Unit	Course Content	Periods
I	History of Making of the Indian Constitution 1.1 History 1.2 Drafting Committee (Composition & Working)	04
II	Philosophy of the Indian Constitution 2.1 Preamble 2.2 Salient Features	06
III	Contours of Constitutional Rights & Duties 3.1 Fundamental Rights 3.1.1 Right to Equality\ 3.1.2 Right to Freedom 3.1.3 Right against Exploitation 3.1.4 Right to Freedom of Religion 3.1.5 Cultural and Educational Rights 3.1.6 Right to Constitutional Remedies 3.2 Directive Principles of State Policy 3.3 Fundamental Duties	12
IV	Organs of Governance 4.1 Parliament 4.1.1 Composition 4.1.2 Qualifications and Disqualifications 4.1.3 Powers and Functions 4.2 Executive 4.2.1 President 4.2.2 Governor 4.2.3 Council of Ministers 4.3 Judiciary 4.3.1 Appointment and Transfer of Judges 4.3.2 Qualifications 4.3.3 Powers and Functions	08

LEARNING OUT COME:-

1. Students will know the history and the process of drafting of the constitution.
2. Students will be enlighten about the philosophy of the constitution.
3. Students will be aware about the Rights and duties of the Indian Citizen.
4. Students will come to know the functional bodies of the Indian Government.

Suggested Readings :

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar Framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn. Lexis Nexis, 2014.
4. D. D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5. M. P. Jain, Outline of India Legal and Constitutional History, Lexis Nexis, 2014.
6. ग्रॅनव्हिल ऑस्टीन, भारतीय राज्यघटना राष्ट्रीय कोनशीला, डायमंड प्रकाशन, पुणे, २०१३.
7. डॉ. भा. ल. भोळे, भारताचे शासन आणि राजकारण, विद्या प्रकाशन, नागपूर.

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL DEVELOPMENT &
RESEARCH**

Course Code No.: RTB-111	No. of Credits: 04	Hours: 60
Course Title:	NATURAL RURAL RESOURCES : ASSESSMENT AND MANAGEMENT	
Course Objectives:		
<p>1. To understand the nature and characteristics of rural resource and its importance in Rural Development.</p> <p>2. To understand various resources available in rural India such as land, water and human and other Resources.</p>		
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.	12
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.	12
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.	12
IV	Living Resources:- Vegetation – Types of uses, Importance as resource- Timber, fuel, construction, agricultural, plantation, raw material, Forest rights and Joint	12

	<p>forest management, Wide life- Diversity of life, it's role in ecology, resources potential, Nature of conflict between wide life and Farmers in Konkan.</p> <p>Human Resources:-</p> <p>Quantitative aspects of rural human resource – Gender & Age wide classification, Density, Issue in rural human resources- Scarcity, lack of skill, attitude, social status.</p>	
V	Government initiatives and participation of various Stake holders for development and Protection of Rural resources .	12

Course 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.

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

Course Code No.: RTR-112	No. of Credits: 04	Hours: 60
Course Title:	RESEARCH METHODOLOGY	
<u>Course Objectives</u>		
<ol style="list-style-type: none"> 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 will get the knowledge of data collection, tabulation, analysis and presentation of data. 4. Students can know how to collect the research data through experimentation, questioner, by direct observations and sensitivity study of spatial and temporal data. 5. Students will know importance of statistical analysis, errors occurring in the collected research data and proper interpretation of research analysis. 6. 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

Course Outcomes

Students should be able to:

1. Explain the different research approaches, scientific methods, criteria for good researches.
2. Describe the problems encountered while working on research plan, field and laboratory problems.
3. Collect research data through experimentation, questionnaire by direct observations and sensitivity study of spatial and temporal data.
4. Infer the importance of statistical analysis, errors occurring in the collected research data and proper interpretation of produced research
5. Design the research project with the help of review of produced research, techniques of interpretation, published literature and proper layout of research.
6. 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, A Concise Guide for Master & Ph.D. students in management science, by Jan Jonker&BartjanPennink, Springer.

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTC-113	No. of Credits: 04	Hours: 60
Course Title:	CROP PRODUCTION TECHNOLOGY	
Course Objectives		
<ol style="list-style-type: none"> 1. To prepares students to operate enterprises related to crop production 2. To make students aware of technology in producing cereal grain, fiber, 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.;	12
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.;	12
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.	12

	Forage crops-berseem, lucerne and oat. medicinal and aromatic crops -mentha, lemon grass and citronella,	
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.;	12
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	12

Course 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
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Course Code No.: RTC-114	No. of Credits: 04	Hours: 60
Course Title:	IRRIGATION TECHNIQUES	
Course Objectives		
<ol style="list-style-type: none"> 1. To familiarize students with concepts and fundamentals of agricultural production system 2. To enable students, thorough understand soil-waterplant relationships 3. To give students comprehensive knowledge of crop water requirement 4. and its estimations 5. To introduce students with basic criterions of irrigation project evaluation 		
Unit	Course Content	Periods
I	Measurement of Land, i.e. size, shape, Calculation formulae, Land shaping, Leveling, grading, Measurement of slope & it's methods.	12
II	Measurement of water storage, flows, instruments used, Application methods for different types of crops, Furrows, Basin, Raised beds, Borders.	12
III	Different crops; Horticulture, sericulture, cereals, Pules, cash crops, their stages, crop water requirements, formulae, Evapotranspiration of crops.	12
IV	Pressurized irrigation systems, types, Sprinkler irrigation – parts, functioning, Layouts, Evaluation Maintenance & Repairing, Government facilities.	12
V	Drip irrigation – Parts, layout, functioning, Evaluation, Government. facilities, underground systems & miscellaneous.	12

Course Outcomes

By completing this course, the student will be able to:

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

Suggested Readings

1. “Drainage Engineering” by Luthin J N
2. “Irrigation -Theory and Practice” by Michael A M
3. “Irrigation Engineering” by Gurcharan Singh
4. “Irrigation And Drainage” by LENKA D
5. “Irrigation and Drainage Engineering” by Peter Waller and Muluneh Yitayew

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTC -121	No. of Credits: 04	Hours: 60
Course Title:	Food Processing Tech.-I	
Course objectives: To learn and understand the basic principles and various methods of food preservation		
Unit	Course Content	Periods
I	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.	12
II	Post-harvest Handling Steps in Post-harvest handling–Harvesting stages–maturity indices of fruits and vegetables, Sorting and Grading-Precooling, Pretreatments-Importance of packing–Types of Packages used for packing of commercial products- Methods of storage– transportation.	12
III	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.	12
IV	Processing Technologies Concept – steps and Principles - methods of preservation - important commercial methods like - Canning, preparation of Jam, Jelly, Pickles, Squash, Marmalade, etc.	12
V	Entrepreneurship Development in Agri - based processing industries Scope of self – employability – Present scenario - licensing and FSSAI registration aspects - list of machineries used in processing industry - marketing strategies.	12

Course Outcome:-

The students will get exposure to different technologies of food processing and will have hands on experience of preparation of various processed products.

Suggested Readings:

1. Principles of Meat Science - F. J. Forrest
2. Meat Hand Book - Albert Levie
3. Developments in Meat Science Vol. I & II - Ralston Lawry
4. Poultry Production - R. A. Singh
5. Meat Technology - Gerard F.
6. Fish Processing in India - M. N. Moorjani
7. Fish as a Food Vol. I, II and III - Borgstrom G.
8. Fishery By-products Technology - Brody J.
9. Outline of Meat Science & Technology-B.D. Sharma
10. Modern Abattoir Practices & Animal Byproducts Technology- B.D. Sharma

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
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Course Code No.: RTC-122		No. of Credits: 04	Hours: 60
Course Title:		WATERSHED MANAGEMENT – I	
<p>1.To understand different watershed behavior</p> <p>2.To be able to interpret runoff data and quantify erosion by using various modeling Methods</p> <p>3. To understand land use classification and impact of land use changes on hydrological cycle Parameters</p>			
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)		12
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)		12
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)		12
IV	Treatment on land – Tree plantation, grasses, contour trenches, compartment bunding, land leveling, grading, smoothening, farm ponds, recharging of wells bores, Mapping, Scales, Symbols, drawings. Land capability & land use planning. (Theoretical & analytical)		12
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)		12

Course outcomes

Students will be able to;

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 Rainwater Technology Handbook: Rainharvesting 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
4. “Hydrology and Water Resources Engineering” by S K Garg
5. “Engineering Hydrology” by K Subramanya

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
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Course Code No.: RTC-123	No. of Credits: 04	Hours: 60
Course Title:	ANIMAL HUSBANDRY	
Course Objective :		
<p>1.To increase awareness amongst the rural masses regarding improved Animal Husbandry practices</p> <p>2.To provide gainful self-employment to the weaker sections of the society in livestock sector</p> <p>3.To create and maintain a "Disease Free Status" of major production areas so as to boost export of livestock products</p>		
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.	10
II	Measures and factors affecting fertility in livestock, reproduction behavior like estrus, parturition, etc Milk secretion, milking of animals and factors affection milk yield and composition.	10
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.	10
IV	Different type of animal housing principles space requirement for different species of livestock. Disease control measures sanitation and care breeding and production records.	10
V	Disease control measures, sanitation and care breeding feeding and management, incubation hatching and vaccination and prevention of diseases	10
VI	Preservation and marketing of eggs it's economics and keeping quality cost of production of milk, economical units of cattle, buffalo, sheep & goat.	10

Course Outcomes

1. Determine and know the standards of care for animals in a colony setting.
2. Use safe handling techniques and aids for moving and restraining healthy cats and dogs.
3. Observe and document typical behaviors, attitudes and health indicators of cats and dogs.
4. Carry out industry standard animal husbandry activities within a colony setting.

Suggested Readings

1. A Textbook Of Animal Husbandry- G C Banerjee
2. Advanced Animal Nutrition- D. V Reddy
3. Agricultural Economics- S Subba Reddy
4. Animal husbandry & veterinary science- T.N. Palanivelu
5. Animal Husbandry- Gyan Deep Singh, Anmol Publishers
6. Animal Physiology- K. A. Goyal, Rastogi Publishing
7. Animal Physiology- KavitaJuneja, Anmol Publishers
8. Basics Of Animal Physiology- MonalisaKar, Anmol Publishers
9. Biotech's Dictionary Of Animal Husbandry – Daya Publishing
10. Biotechnology Expanding Horizons – B D Singh, Kalyani Publishers

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTE-124 A	No. of Credits: 04	Hours: 60
Course Title:	CLIMATE CHANGE AND CONSERVATION OF BIODIVERSITY	
Course Objectives		
<ol style="list-style-type: none"> 1. To educate and train early to mid-career conservation researchers and practitioners to enable them to make substantive contributions in addressing biodiversity conservation issues in a changing climate. 2. To equip professionals with innovative knowledge, skills and values in biodiversity conservation in a changing climate integrated in order to enhance understanding of current natural resource management and environmental issues. 		
Unit	Course Content	Periods
I	Climatology: Weather and climate, Control of Climate, The Climate System , Climate Anomaly, Variability and change, Koppen's classification of Climate.	12
II	Climate of India, clouds and precipitation, Possible Global climate Change, Green house effect, Green house gases, stratospheric ozone, Strategies for protecting stratospheric ozone.	12
III	Pollution: definition, causes, effects and control measures of Air pollution, water pollution, soil pollution, Noise pollution, Pollution case studies.	12
IV	Biodiversity: Definition, levels of biodiversity, uses of biodiversity, distribution of biodiversity, ecological concept, hot-spots of biodiversity, threats of biodiversity, conservation of biodiversity, India's biodiversity and its conservation, endangered threatened and rare species, International Union for Conservation for Nature (IUCN) red list categories.	12
V	Sustainable development and ecological economics, causes of un-sustainability, national and international programme on sustainable development, sustainability indicators, environmental sustainability index, sustainability development in India.	12

Course Outcomes :

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Articulate why society strives to conserve biodiversity.
2. Identify key threats to biodiversity.
3. Evaluate which management options are likely to be effective for conserving biodiversity in different settings.
4. Develop appropriate policy options for conserving biodiversity in different settings.
5. Communicate informed critique or analysis of biodiversity conservation policy and practice across a range of mediums.

Suggested Readings

- Ecology Environment and Resource Conservation : J.S. Singh, S.P. Singh, S.R. Gupt, Anamaya Publishers, F-154/2, LadoSarai, New Delhi-110030, India.
- Climatology An Atmospheric Science : John E. Oliver, John J. Hidore, Dorling Kindersley (India) Pvt. Ltd.
- Climate Change and Global Warming: AvinashTyagi, Rajat Publications 4675/21, Ansari Road, Daryaganj New Delhi-110002 (India)
- Cold Climate Hydrometeorology: D.S. Upadhyay, Wiley Eastern Ltd., 4835/24, Ansari Road, Daryaganj, New Delhi- 110002 (India).

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTE-124B	No. of Credits: 04	Hours: 60
Course Title:	Greenhouse Technology	
<ol style="list-style-type: none"> 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	Green house technology- Introduction , Components and design of green houses, Advantages, Applications in agriculture Fundamentals of Green House Technology	12
II	Structure and Construction of a Green House. Designing and layout of green house, laying the greenhouse	12
III	Installation of greenhouse structure, erection of greenhouse structure Covering the greenhouse with nets and sheets	12
IV	Checking the first time leakages through the gutter Maintenance of greenhouse	12
V	Greenhouse Technology- Instruction in greenhouse structures and greenhouse environment regulations. Plant growth, development and propagation, production and maintenance of bedding and container produced plants.	12

Course Outcome

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

Suggested Readings :

1. Greenhouse Technology for Controlled Environment 2009 by G.N. Tiwari
2. Greenhouse Technology - Management, Operations and Maintenance 2016 by N. N. Patil
3. Greenhouse Technology and Management 14 December 2012 by Nicolas Castilla and Esteban Baeza
4. Greenhouse Technology And Management 2016 by HernaDez Jose Del Sagrado

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTC-231	No. of Credits: 04	Hours: 60
Course Title:	Food Processing Tech.-II	
Course Objectives		
<ol style="list-style-type: none"> 1. To explain major food preservation techniques and underlying principles. 2. To understand the technology available in Australia for food processing. 3. To determine suitable methods of processing techniques for a chosen food. 4. To understand novel food processing methods including non thermal food processing techniques. 		
Unit	Course Content	Periods
I	<p>Agro processing industry</p> <p>Introduction and scope of agro processing industries in India, Maharashtra and Marathwada. Status, Production and utilization of Wheat, rice and pulses in India and the world. Factors affecting quality of food grains. Scope of agro processed products for entrepreneurship. The chemical compositions and nutritional values of cereal, Wheat, rice, pulses and oil seeds. Importance of cereal, Wheat, rice, pulses and oil seeds in diet. Distribution of vitamins, protein, minerals, carbohydrates and fats in different grains and their relevance to milling.</p>	12
II	<p>Grain Milling</p> <p>Pre milling treatments of Wheat, rice and pulses milling and recent developments. Principle of Wheat, rice and pulses milling. Wheat, rice and pulses suitable for milling. Different Methods of Wheat, rice and pulses milling, Working and principle of Wheat, rice and pulses mills. Pre-treatment in Wheat, rice and pulses milling. Packaging, labeling, storage and marketing of whole grains. Study the various type of packaging materials used in agro processing industry.</p>	12
III	<p>Spices processing</p> <p>Types of Spices grown in Maharashtra, Production of major spices in India & their importance in Indian diet. Spices suitable for processing. Unit operations in spices processing: Principles, method and machinery in spice grinding. Quality assurance & methods to detect adulteration.</p>	12
IV	<p>Oil Extraction, Refining and purification</p> <p>Importance and functions of oils in food and health. Different methods of oil extractions, oil expression from oilseeds like mustard/rapeseed, coconut, sunflower, groundnut, sesame and cotton. Different types of oil expellers. Oilseeds, properties and suitability.</p>	12

	Process flow chart of oil extractions. Filtration and packaging. Oil refining and purification: Refining, purification, deodorization, stabilization and hydrogenation.	
V	<p>Products and Waste utilization of agro processing industries:</p> <p>Recovery and utilization of starch, gluten, dextrin, dextrose, bran, bran oil, Germ and germ oil, husk, hulls of pulses, soybean meal and hulls, protein isolates, high fructose corn syrup, corn liquor, yellow and white dextrin and dextrose powder. Varietal effects on processing of cereals and pulses. Introduction to operation Green revolution. Knowledge of importance on Agro-Industries Product in food Industry & its market value. Introduction of agro processing industry. Scope of agro processed products for entrepreneurship. Knowledge about the sources of accidents. Known the necessary safety & precautions taken in each machines. Known to prevention overcome from accidents.</p>	12

Course Outcome

Upon successful completion of this course student should have the ability to:

1. Define key terms and explain processing and engineering principles related to addition or removal of heat in food and resulting quality.
2. Explain the principle of thermal death kinetics of food-borne microorganisms in achieving the desired preservation and the effects on product quality
3. Solve simple numerical problems associated with processing of foods, including thermal death kinetics

Suggested Readings :

1. Agricultural Planning and Technology in Rural Development- A. K. Mitra, B. Sahoo (editors) M D Publication Pvt. Ltd. New Delhi.
2. Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices- Amalendu Chakraverty, Arun S. Mujumdar, Hosahalli S. Ramaswamy
3. Post-Harvest Technology of Horticultural Crops-by K.P. Sudheer and V. Indira
4. Postharvest Technology of Fruit and Vegetables by A. K. Thompson
5. Bakery Science and Cereal Technology-Neelam Khatarpaul
6. The Complete Book on Spices & Condiments (with Cultivation, Processing & Uses)- By NIIR Board of Consultants & Engineers

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTC-232	No. of Credits: 04	Hours: 60
Course Title:	WATERSHED MANAGEMENT – II	
Course Objectives		
<p>1.To understand different watershed behaviour</p> <p>2.To be able to interpret runoff data and quantify erosion by using various modelling methods</p> <p>3.To understand land use classification and impact of land use changes on hydrological cycle Parameters</p>		
Unit	Course Content	Periods
I	Surveying - Instruments in surveying, chains, leveling staff, cross staff, compass & its types, Dumpy level, the odolite, total station, contours. Temporary adjustments, Levels, reduction of levels, contouring, block contouring, interpolation of contours. (Theoretical & analytical)	12
II	Geography – Topography & its features, Ridges, Valleys, drainage, Drainage density, water & land-present status, Maharashtra, India, Basins of Maharashtra, Basins of India- Maps & Toposheet reading. (Theoretical & analytical)	12
III	Hydrology - Hydrologic cycle, catchments, Isohytes, Yield computation, hydrographs, unit hydrograph, river gauging, cross section & L Section of River. (Theoretical & analytical)	12
IV	Geology - Rock formation their characteristics – definitions, types of rocks, rocks in Maharashtra, Ground water, Digging of wells, Yield of well. Soil & its formation, physical & chemical properties of soil, significance of soil in water & land management, soil testing. (Theoretical & analytical)	12
V	Crops & their classification, cropping pattern, farming system, agro technology, crop water requirements, crop yield response to water, water application methods, organic farming, group farming, farming machinery. Legal aspects of water management, ground water law, different forms used in farming i. e. revenue department, irrigation department. (Theoretical & analytical)	12

Course outcomes

Students will be able to;

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. Knighton, D. 1984. Fluvial forms and processes. London: Edward Arnold
2. Gregory, K.J. and D.E. Walling. 1973. Drainage basin form and process: A geomorphological approach. London: Edward Arnold.
3. Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. Stream hydrology: An introduction for ecologists. Chichester: John Wiley & Sons.
4. Field Hydrogeology by John E. Moore
5. Geological Engineering by Luis Gonzalez de Vallejo; Mercedes Ferrer

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTC-233	No. of Credits: 04	Hours: 60
Course Title:	ICT in Rural Development Technology	
<p>Course Objective/s:</p> <ol style="list-style-type: none"> 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. 		
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.	12
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.	12
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).	12
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.	12
V	<p>Case Studies, Demonstrations and Field Work: Example: -Rural: MGNREGA, Watersheds, E-Governance: Decentralized Planning, Agricultural: Plantation, Geo-tagging of Rashtriya Krishi Vikas Yojana (RKVY), Pest Surveillance, Pradhan Mantri Krishi Sinchayee Yojana (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.</p>	12

Course Outcome/s:

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.

Suggested Readings :

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 (GeoICT). Springer.
10. Goswami, D., Bhattacharya, S., & Barbhuiya, F. A. (2012). Information and Communication Technology for Education, Healthcare and Rural Development. Narosa Pub House.
11. http://bhuvan.nrsc.gov.in/bhuvan_links.php
12. <https://elearning.iirs.gov.in/>
13. <http://www.sac.gov.in/Vyom/ea.jsp>

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTE-234 A	No. of Credits: 04	Hours: 60
Course Title:	Organic Farming	
Course Objectives : The purpose and intent of Organic farming is to acquaint students with the principles and practices of sustainable and organic production of crops and the issues that affect such producers.		
Unit	Course Content	Periods
I	Organic farming – Introduction, concept, advantages and disadvantages, relevance in present context, organic production requirements. Biological intensive nutrient management	12
II	Organic manures : FYM, compost, vermin composting green manuring; Recycling of organic residue and bio fertilizers	12
III	Soil improvement and amendments; Integrated weed, disease and pest management	12
IV	Use of bio-control agents, bio-pesticides, pheromones, trap crops, bird perches, weed management.; Quality consideration, certification, labeling and accreditation process, marketing and exports.	12
V	Meaning and importance of rainfed farming, problems, soil and climatic studies of rainfed farming, characteristics of rainfed areas	12

Course Outcomes :

Upon successful completion of this course, students will be able to:

1. Define sustainable agriculture and agroecosy stem and describe how these systems function.
2. Analyze the effects and future impact of current agricultural practices on the environment, local economy and physical/social well-being of society.
3. Evaluate how governmental policies and new technologies have influenced agricultural practices.

4. Evaluate the sustainability of organic production and recommend policy changes and new technologies to improve sustainability.

Suggested Reading

1. A.K.Dahama. 2007. *Organic farming for sustainable agriculture*. Agrobios (India), Jodhpur.
2. Arun. K. Sharma. 2011. *Handbook of Organic farming*. Agrobios (India), Jodhpur.
3. A.C.Gaur. *Handbook of Organic farming and biofertilizers*.
4. S.P. Palaniappan and K.Annadurai. 2010. *Organic farming – Theory and Practice*. Scientific Publishers. Jodhpur.
5. U.Thapa and P. Tripathy. *Organic farming in India- Problems and Prospects*.
6. G.K.Veeresh. 2006. *Organic farming*. Foundation Books. New Delhi.

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTE.-234B	No. of Credits: 04	Hours: 60
Course Title:	RURAL TOURISM	
Course Objective/s: To understand the concept of Rural Tourism, different models, its impact on society and rural market.		
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.	12
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.	12
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.	12
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.	12
V	Practical experience & project on rural Tourism, Presentation of case study, development of rural tourism model. Field visit.	12

Course Outcome/s:

1. Student will enable to understand different tourism types & rural tourism models & its future potential.
2. Student will aware about theme of rural tourism, its component, its impact on society and rural market share.
3. The students will come to know about potential of rural tourism in employment generation for rural youth and women & role of rural tourism in sustainable development of rural India.

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 Development 1 December 2006 by S.B. Verma and S.K. Jiloka
4. Rural Tourism: New Concepts, New Research, New Practice 19 September 2017 by Bernard Lane and Elisabeth Kastenholz
5. International rural tourism development: an Asia-Pacific perspective 1 July 2017 by World Tourism Organization
6. Tourism and Rural Management 2 September 2013 by Dr. Rais Ahmad

**GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL
DEVELOPMENT & RESEARCH**

Course Code No.: RTC-241	No. of Credits: 04	Hours: 60
Course Title:	Agricultural Biotechnology	
Course Objectives :-		
<ol style="list-style-type: none"> 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.	12
II	Carbon Assimilation; Light absorption and energy conversion; Calvin Cycle; Hatch- Slack pathway; Reductive pentose phospho 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.	12
III	History of plant cell and tissue culture, Culture media; Various types of cultures: callus, cell suspension, nurse, root, meristem, <i>In Vitro</i> 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;	12
IV	Unit 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.	12
V	Conventional methods for crop improvement: Principles of plant	12

	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.	
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Practical's :-

1. Plant DNA extraction, digestion of DNA with restriction enzymes, agarose gel electrophoresis.
2. Polymerase chain reaction to amplify a plant gene.
3. Homogenization of leaves, sub-cellular fractionation by differential centrifugation, chloroplast purification, SDS-PAGE analysis of chloroplast proteins.
4. RNA extraction, Agarose gel electrophoresis of RNA, RT-PCR analysis of a plant gene.
5. Preparation of Murashige and Skoog medium, stocks of macronutrients, micronutrients, vitamins and hormones, autoclaving, filter sterilization of hormones and antibiotics.
6. Surface-sterilization of seeds, establishment of axenic plants, acclimatization of tissue culture plants and establishment in greenhouse.
7. Callus induction in tobacco leaf discs, regeneration of shoots, root induction, role of hormones in morphogenesis.
8. Anther culture
9. Protoplast isolation viability test and culture

Course Objectives :-

The Student Learning Outcomes for the Bachelor of Agricultural Biotechnology are:

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 Ganguli

GOPINATHRAO MUNDE NATIONAL INSTITUTE OF RURAL

DEVELOPMENT & RESEARCH

Course Code No.: RTC-242	No. of Credits: 04	Hours: 60
Course Title:	Biomass Management & Utilization	
Course Objectives:-		
<ol style="list-style-type: none"> 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 Overview of 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.	12
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	12
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.	12
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	12
V	Chemical conversion of biomass for energy production 5.1 Chemical conversion processes 5.2 Hydrolysis and hydrogenation	12
VI	Synthesis biofuel 6.1 Modern biofuel synthesis 6.2 Bio- refinery	
VII	Thermo chemical conversion of biomass 7.1 Combustion in excess oxygen and oxygen deficient atmosphere 7.2 Pyrolysis, Carbonization, Charcoal production 7.3 Biomass gasification--different types--power generation from gasification	

	7.4 Biomass based power generation	
VIII	Energy plantation 8.1 Overview on energy plantation 8.2 Basis of selecting the plants for energy plantation 8.3 Waste land utilization through energy plantation Suggested reading	

Course Outcome:-

1. Students will understand and acquire 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, maintenance and auditing of Energy Management Systems
3. Will become capable of analysis and design of energy conversion systems
4. Acquired skills in the scientific and technological communications, and in the preparation, planning and implementation of energy projects

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

Course Code No.: RTE-243A	No. of Credits: 04	Hours: 60
Course Title:	Power Systems For Renewable Energy Sources	
Course Objectives-		
<ol style="list-style-type: none"> 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.	12
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	12
III	Introduction to induction machines: electrical characteristics, slip, speed-torque characteristics etc. Self-excited induction generator, Constant speed Induction generators, Variable speed Induction generators, doubly fed Induction generators.	12
IV	Introduction to power electronic devices, AC/DC converters, PWM, THD. Permanent magnet synchronous generator, solar PV systems, fuel cell, aquaelectrolizer	12
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).	12
VI	Power quality management (voltage dips, harmonics and flickers).Frequency management. Influence of WECS on system transient response – IEEE standard and Polices.	

Course Outcome

At the successful completion of this course, the student is expected to have/be able to:

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

Course Code No.: RTE-243B	No. of Credits: 04	Hours: 60
Course Title:	Apiculture	
Course Objectives :-		
<p>This course is generally a stand alone course, but to some degree relies on the students' knowledge gained from previous courses especially Introductory entomology, Biochemistry and general Physiology</p>		
Unit	Course Content	Periods
I	<p>Introduction of Modern bee keeping</p> <p>1.1. Importance of beekeeping, Potential of beekeeping in Maharashtra and India</p> <p>1.2. Taxonomy, diversity of bee species</p> <p>1.2.1 Taxonomic position, diversity, habit, habitat and nesting behavior of honey bees</p> <p>1.3. Colony organization and life cycle of honey bee</p> <p>1.3.1. Cast differentiation, Colony organization (Social organization) and Division of labor in honeybee</p> <p>1.3.2. Life cycle of honeybee and nuptial flight</p>	12
II	<p>. Obtaining and installing of bee colony</p> <p>2.1. Purchasing established colony, Methods of Swarm capturing,</p> <p>2.2. Hiving by dividing an established colony –making two hives from one, making one hive from two</p> <p>2.3. Handling of the bee colony</p> <p>2.4. Location and establishment of apiary</p>	12
III	<p>.Scientific beekeeping</p> <p>3.1. Basic Beekeeping equipments for beekeepers</p> <p>3.2. Commercial bee keeping</p> <p>3.3. Seasonal management of apiary and basic inspection techniques of bee colonies.</p> <p>3.4. Problems of beekeeping industries, Natural climate condition, Natural enemies and bee pest, Human Activities, Pesticide bee poisoning.</p> <p>3.4.1. Bee diseases and remedies, Brood diseases, Adult bee diseases.</p> <p>3.4.2. Apiary and Hive Hygiene</p>	12
IV	<p>Apiculture in Agriculture</p> <p>4.1. Bee plants and floral calendar- Importance and qualities of good bee flora.</p> <p>4.2. Pollination,</p> <p>4.2.1. Role of honey bees in pollination of agricultural crops and its benefits</p> <p>4.5.2. Management of honeybees for improved pollination.</p>	12

	<p>4.5.1. Foraging strength and requirement of honeybee colonies, and their distribution in the crop.</p> <p>4.5.3. Pollination in green house cages.</p> <p>4.6. Constraints in the development of beekeeping on agricultural belts</p> <p>4.6. Improvement of bee forage.</p> <p>4.8. Migratory beekeeping</p>	
V	<p>Honeybee products for health</p> <p>5.1. Honey- Its constituents, methods of collection and uses.</p> <p>5.2. Importance of other bee products to mankind</p> <p>a) Pollen –Method of collection, constituents, uses.</p> <p>b) Royal jelly- Method of collection, constituents, uses.</p> <p>c) Propolis - Method of collection, constituents, uses.</p> <p>d) Bee wax- Method of collection, constituents, uses.</p> <p>e) Bee venom- Method of collection, constituents, uses.</p> <p>f) Beethearpy</p>	12

Course Outcome:-

- Describe the importance, biology and management of bees.
- Demonstrate bee keeping management skills
- Apply the knowledge on bee biology and management to the development of the bee industry in tropical environments.
- Evaluate beekeeping project for cost-effectiveness and sustainability.

Practical's corresponding to supportive course

- 1) Study of external morphology of honeybee
- 2) Study of Indian species of honeybee
- 3) Study of life cycle of honeybee
- 4) Study of architecture of honey comb
- 5) Study of diseases, pests, parasites and predators of the honeybee
- 6) Study of bee keeping equipments and their uses
- 7) Study of artificial bee breeding technique
- 8) Preparation of floral colander of bee plants in area
- 9) Study of methods of collection and preservation of honey,wax,pollen,propolish,Royal jelly and bee venom.
- 10) Maintenance of honeybee colony (Compulsory Rearing of live colony) in college campus

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

Course Code No.: RTS-239	No. of Credits: 04	Hours: 60
Course Title:	GREENHOUSE TECHNOLOGY	
Course Objectives <ol style="list-style-type: none">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 industry2. To develop the additional skills.3. To make students aware of Greenhouse construction and management skill.		
Syllabus <ol style="list-style-type: none">1. Green house technology- Introduction , Components and design of green houses, Advantages, Applications in agriculture2. Fundamentals of Green House Technology3. Structure and Construction of a Green House4. Designing and layout of green house, laying the greenhouse5. Installation of greenhouse structure, erection of greenhouse structure6. Covering the greenhouse with nets and sheets7. Checking the first time leakages through the gutter8. Maintenance of greenhouse9. Greenhouse Technology- Instruction in greenhouse structures and greenhouse environment regulations.10. Plant growth, development and propagation, production and maintenance of bedding and container produced plants.		

Course Outcome

3. The students will get acquainted with greenhouse technology
4. Students will acquire the management skills for greenhouse.

Suggested Readings :

1. Greenhouse Technology for Controlled Environment2009by G.N. Tiwari
2. Greenhouse Technology - Management, Operations and Maintenance2016by N. N. Patil
3. Greenhouse Technology and Managemen14 December 2012by Nicolas Castilla and Esteban Baeza
4. Greenhouse Technology And Management2016by HernaDez Jose Del Sagrado