COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Mechanical Engineering
Curriculum Structure

B. Tech
Mechanical Engineering

MDM Courses: Agricultural Science and Smart Farming

(Effective from: A.Y. 2023-24)

COEP TECHNOLOGICAL UNIVERSITY, PUNE
A Unitary Public University of Government of Maharashtra
(Formerly College of Engineering Pune)
School of Mechanical and Materials Engineering
Wellesley Road, Shivajinagar, Pune - 411005

UG Mechanical Engineering
MDM Courses: Agricultural Science and Smart Farming

Sr. No.	Semester	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightage in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	IV	MDM I	Agriculture Fundamentals	3	0	0	1	3	30	10	60	--	--
02	V	MDM II	Biomass Processing Technologies	3	1	0	1	4	30	20	50	CIE: 100	
03	VI	MDM III	Farm machinery and Food processing	3	1	0	0	4	30	20	50	CIE: 100	
04	VII	MDM IV	Advances in agriculture and smart farming	3	0	0	1	3	30	10	60	--	
Total				**12**	**2**	**00**	**3**	**14**					

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Course: Agriculture Fundamentals

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
MDM I	Agriculture Fundamentals	3	0	0	1	3	30	10	60	--	--

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Understand the importance of Agriculture and other associated occupation related to Agriculture in Indian economy.
2. To familiarize the students with soil and physical, chemical and biological properties of soil.
3. To introduce the students with varied cultivation practices including handling of different manures, fertilisers, pesticides, fungicides and herbicides.
4. To develop knowledge about different farming systems, cropping pattern, different important schemes and policies related to Agriculture.

Syllabus:

Unit	Contents	Hrs.
1	**Agricultural Sciences Foundation:** Targets and achievements in foodgrain production in India since independence and its future projections, sustainable crop production, commercialization of agriculture and its scope in India , Classification of field crops based on their utility-cereals, pulses, oils seeds, fibre, sugar, and forage crops. Introduction to Agricultural Botany, Principles of Plant Physiology, Agricultural Chemistry. Biochemistry: pH and buffers, Classification and nomenclature of carbohydrates; proteins; lipids; vitamins, and enzymes0020	
2	**Soil, Soil fertility, Fertilizers, and Manures:** Soil, soil pH, Soil texture, soil structure, soil organisms, soil tilth, soil fertility, and soil health. Essential plant nutrients, their functions, and deficiency symptoms. Soil types of India and their characteristics. Organic manure, common fertilizers including straight, complex, fertilizer mixtures and biofertilizers; integrated nutrient management system	
3	**Crop Production and Management:** Crop Cultivation Techniques, Principles of Agronomy, Seedbed preparation, seed treatment, time and method of sowing/planting, seed rate; dose, method, and time of fertilizer application, irrigation,	

	intercultural and weed control; common pests and diseases, caused by bacteria, fungi viruses, and nematode and their control, integrated pest management, harvesting, threshing, postharvest technology: storage, processing, and marketing of major field crops-Sugarcane, Rice, wheat, maize, sorghum, pearl millet, groundnut, mustard, pigeon-pea, gram, cotton, and berseem. Organic Farming and Sustainable Agriculture. Principles of weed control, methods of weed control.	
4	**Horticulture:** Importance of fruits and vegetables in the human diet, Crop diversification & processing Industry. Orchard- location and layout, ornamental gardening, and kitchen garden. Planting system, training, pruning, intercropping, protection from frost and sunburn. Trees, shrubs, climbers, annuals, perennials-definition and examples. Propagation by seed, cutting, budding, layering, and grafting. Cultivation practices, processing, and marketing of (i) Fruits - mango, papaya, banana, guava, citrus, grapes. (ii) Vegetables - Radish, carrot, potato, onion, cauliflower, brinjal, tomato, spinach, and cabbage. (iii) Flowers - Gladiolus, canna, chrysanthemums, roses and marigold. Principles and methods of fruit and vegetable preservation. Preparation of jellies, jams, ketchup, chips and their packing.	
5	**Irrigation :** Concepts, Sources, Types of Irrigation with Special Emphasis on MicroIrrigation, Fertigation. Water requirement of crops, Irrigation Requirements, Irrigation Efficiency and Scheduling of Irrigation. Drainage–concept, types and importance.	
6	**Overview of Major crops in India** : Classifications of crops. Types of crops based on seasons Kharif Crops, rabbi crops,Zaid Crops.Types of crops based on usage food crops, Forage crops,Fibre crops Oil crops, Ornamental crops Industrial (cash) crops. Types of crops based on life cycle Annual crops, Biennial crops,Perennial crops. overview and details of sugarcane, and bamboo crops.	

Suggested learning recourses:

Textbooks:

1. N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishing House, Anand (India)
2. M.L.Dabhade, "Engineering Graphics" I, Vision Publications, Pune
3. Dhananjay Jolhe, "Engineering Drawing", Tata McGraw Hill publishing company Ltd., New Delhi.

Reference Books:

1. Warren Luzzader, "Fundamentals of Engineering Drawing", Prentice Hall of India, New Delhi.
2. Shah, M.B. & Rana B.C.), "Engineering Drawing and Computer Graphics", Pearson
3. Education Agrawal B. & Agrawal C. M. , "Engineering Graphics", TMH Publication

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Course: Biomass Processing Technologies

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
MDM II	Biomass Processing Technologies	3	1	0	1	4	30	20	50	CIE: 100	

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Classify different types of biomass, including lignocellulosic materials and bio-based wastes, and their roles in producing energy and chemicals.
2. Describe the principles of biorefineries and the economic aspects of process integration and product options.
3. Understand the processes for producing bioethanol and apply Monod kinetics to optimize fermentation.
4. Assess technologies like gasification and pyrolysis for energy production and resource recovery.

Syllabus:

Unit	Contents	Hrs.
1	**Introduction to Biomass Energy :** Global energy scenario and fossil fuel depletion. Biomass as a renewable energy source. Availability, abundance, and energy potential of biomass. Photosynthesis and energy production. Types of biomass: virgin, waste (municipal, industrial, agricultural, forestry). Energy crops: maize, sorghum, sugarcane, perennial herbaceous crops, woody crops. Microalgae as biofuel feedstock. Challenges in improving biomass for biofuel conversion.	
2	**Biorefinery Concepts and Feedstocks :** Introduction to biorefineries. Types of biorefineries and their feedstocks. Feedstock properties and selection. Economic aspects of biorefineries. Market demand, production costs, scalability. Case studies on successful biorefineries.	
3	**Biomass Pretreatment and Conversion Processes :** Challenges in lignocellulosic biomass conversion. Pretreatment methods: acid, alkali, autohydrolysis, hybrid methods. Role of pretreatment in biomass processing. Physical and thermal conversion processes. Equipment, applications, and products. Thermal conversion products: syngas, biooil, biochar. Case studies on successful thermal conversion.	

4	**Microbial Conversion and Biofuels:** Microbial conversion processes. Biodiesel production from vegetable oils, microalgae, and syngas. Transesterification and biodiesel purification. Bioethanol and biobutanol production. Fermentation technologies and microorganisms. Biohydrogen and biogas production. Fuel cell integration. Biooil and biochar production and upgradation.	
5	**Organic Commodity Chemicals and Integrated Biorefineries :** Biomass as feedstock for organic chemicals. Production of lactic acid, succinic acid, acetic acid, PHA. Integrated biorefineries: corn, soybean, sugarcane, lignocellulosic, algal. Hybrid chemical and biological conversion processes. Techno-economic evaluation and life-cycle assessment of biorefineries.	

Useful Learning Resources

Tutorials

1. Overview of biomass energy, including global energy scenarios, biomass types, and their potential as a renewable resource.
2. Introduction to biorefinery concepts, types of feedstocks, economic aspects, and case studies of successful biorefineries.
3. Examination of biomass pretreatment methods, including acid and alkali processes, and their role in improving conversion efficiency.
4. Study of microbial conversion processes for biodiesel, bioethanol, biobutanol, and biohydrogen production, along with fermentation technologies.
5. Exploration of biomass as a feedstock for organic chemicals, including the production of lactic acid, succinic acid, and integrated biorefineries.

Reference Books:

1. "Biomass to Renewable Energy Processes" by Jay Cheng
2. "Biomass Processing Technologies" by Rajesh Kumar Sharma and Sandeep Kumar
3. "The Biorefinery: A Sustainable Approach to the Production of Fuels and Chemicals" by David S. Armenta
4. "Biofuels: Production and Utilization" by S. K. Singh and M. S. Ranjan
5. "Lignocellulosic Biomass for Bioenergy" by R. A. B. D. Bevan

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Advances in Farm Equipment and Food Technology

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
MDM III	Advances in Farm Equipment and Food Technology	3	1	0	1	4	30	20	50	CIE: 100	

Course Outcomes:
Students should be able to:

1. Understand the importance of Farm Machinery and its implementation in context of India.
2. Study the need and implements of Ploughing and its implements
3. Comprehend various Methods and Equipment of Seeding and Planting
4. Learn about different methods of crop Protection and Harvesting
5. Develop understanding of food processing and preservation techniques

Syllabus:

Unit	Contents	Hrs.
1	**Introduction to farm machinery:** Modern trends, principles, procedures, fundamentals and economic considerations of Farm machinery, Importance of farm machinery in the contest of enhanced production, multiple cropping, labour scarcity	
2	**Primary and Secondary Tillage implements:** Definition and Objectives of Tillage, Primary and Secondary Tillage, Physical, Chemical and Biological Influences of Tillage, Concept of ploughing, Tools used for ploughing, Disc Ploughs, Harrows, Seedbed preparation and irrigation	
3	**Seeding and Planting Machines:** Methods of Seeding and Planting and their Mechanization, Tools and Implements for Intercultural Operations, Drills, Planters, Seed and Fertilizer Metering Devices	
4	**Crop Protection and Harvesting:** Objectives and Types of Spraying and Dusting, Working Principle and Components of Sprayers and Dusters, Safety in Handling Plant Protection Machines, Machinery for transport and material handling, Crop Harvesting Methods and their Mechanization, Mowers, Reapers and Windrowers, Pickers and Stripers, Root crop harvesting machinery	
5	**Food processing technology:** General aspects of food industry, world food demand and Indian scenario, quality and nutritive aspects, Food additives, Food additives, Preliminary food processing methods,	

	thermal processing of foods, Steam generation, Fuel utilization, Electric Power Utilization, Process Controls in Food Processing	
6	**Introduction to food preservation:** Objectives and techniques of food preservation, Canning, Preservation principle of canning of food items, Drying techniques, Low temperature food preservation, cold storage, freezing of food products, cryogenic freezing, Preservation by fermentation, Non-thermal and minimal processing technologies, Use of preservatives in foods, packaging of food	

Useful Learning Resources

Tutorials

1. Study of Different Farm Operations and Familiarization with Farm Machines and Equipment
2. Study of Power Requirement of Farm Machines and Equipments
3. Visit to Agriculture farm site to explore various types of Farm machinery
4. Case study to understand food preservation in case of milk products/beverages/poultry farm products/meat

Text Books:

1. Bernacki C, Haman J & Kanafajski CZ.1972. Agricultural Machines Oxford & IBH
2. Arther W Judge 1967. High Speed Diesel Engines, Chapman & Hall
3. Bosoi ES, Verniaev OV & Sultan-Shakh EG. 1990. Theory, Construction and Calculations of Agricultural Machinery Vol. I. Oxonian Press.
4. Food Processing Technology: Principles and Practice (Woodhead Publishing Series in Food Science, Technology and Nutrition),Third addition, June 2009 by P.J. Fellows

Advances in Agriculture Technology and Smart Farming

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
MDM IV	Advances in Agriculture Technology and Smart Farming	3	1	0	1	4	30	20	50	CIE: 100	

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Explore the significance of smart farming, including precision agriculture, automation, and digital technologies, while addressing challenges like climate change and food security.
2. Understand Geographic Information Systems (GIS) for spatial data collection, precision farming, soil mapping, and crop health monitoring through remote sensing.
3. Learn to apply machine learning for predictive modeling of soil conditions and crop yields, enhancing decision-making and resource optimization.
4. Examine the role of automation and robotics in farming, including autonomous machines for planting and harvesting, drones for monitoring, and AI integration for operational efficiency.
5. Discover smart irrigation technologies, including precision systems and automated water control, with a focus on sustainable water management practices.

Syllabus:

Unit	Contents	Hrs.
1	**Introduction to Smart Farming and Agricultural Technologies:** Overview of smart farming and its significance. Key concepts of precision farming, automation, and digital technologies. Role of sensors, drones, and IoT in agriculture. Importance of data-driven decision-making. Addressing challenges such as climate change, resource efficiency, and food security.	
2	**Geographic Information Systems (GIS) in Agriculture:** Introduction to Geographic Information Systems (GIS) in agriculture. Spatial data collection methods and applications. Use of GIS for precision farming and soil mapping. Crop health monitoring through remote sensing. Efficient land management and irrigation planning.	
3	**Machine Learning for Soil and Crop Management:** Application of machine learning in agriculture. Predictive modeling for soil conditions and crop yields. Data acquisition techniques and their practical uses. Role of artificial	

	intelligence in resource optimization. Enhancing crop management efficiency through ML.	
4	**Automation and Robotics in Agriculture:** Advancements in automation and robotics in farming. Use of autonomous machines for planting and harvesting. Applications of drones in agriculture. Robotic systems for spraying and monitoring. Integration of AI and sensors for improved operational efficiency.	
5	**Advances in Agricultural Engineering:** Innovations in agricultural machinery and equipment. Mechanized planting and smart irrigation technologies. Pest control advancements and post-harvest solutions. Focus on sustainable engineering practices. Enhancing productivity while minimizing environmental impact.	
6	**Smart Irrigation and Water Management:** Introduction to smart irrigation technologies. Precision irrigation systems, including drip irrigation. Automated water control methods. Role of sensors and IoT in monitoring soil moisture. Sustainable water management practices to optimize usage.	

Useful Learning Resources

Tutorials

1. Overview of smart farming technologies covering precision agriculture, automation, IoT, and drones.
2. Hands-on experience with GIS software for spatial data collection, soil mapping, and crop health monitoring.
3. Application of machine learning algorithms to predict soil conditions and optimize crop yields.
4. Demonstration of autonomous machines and drones in agriculture, with practical experience in robotic systems.
5. Introduction to smart irrigation technologies, including drip systems and automated water control, with exercises in designing efficient irrigation plans.

Text Books:

1. Precision Agriculture for Sustainability and Environmental Protection by John M. Stafford
2. Smart Agriculture: An Approach to Sustainable Development by R. K. Sharma
3. Agricultural Robotics: Fundamentals and Applications by Rajesh P. Singh and Jagannath P. Singh