SNJB's Late Sau. K. B. Jain College of Engineering, Chandwad
(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)
Curriculum and Evaluation Scheme
To be implemented for 2024-28 Batch
(With Effect from Academic Year 2026-27)

Open Elective
Syllabus for SEM V

24-OEC-3-5-01: Agronics

Teaching Scheme: Theory: 2 Hours/Week	**Credit:** 2	**Examination Scheme:** **CIE** : 20 Marks **SEE** : 30 Marks

Prerequisites Courses: 24-OEC-2-4-01: Precision Agriculture

Companion Course: -

Course Objectives:

- To introduce students to the integration of electronics and communication technologies in agriculture.
- To explore various sensors, embedded systems and wireless communication methods used in precision farming.
- To enable students to design and simulate smart agriculture systems using IoT.
- To encourage application of sustainable technology for improving agriculture productivity.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
CO1	**Discuss** the fundamentals of sensors and actuators used in agricultural systems.	2
CO2	**Illustrate** the fundamental concepts of IoT and describe its applications in agriculture.	2
CO3	**Interpret** the fundamental concepts and agricultural applications of drones and robotics used for crop monitoring and automation**.**	2
CO4	**Apply** embedded automation systems for improving agricultural efficiency.	3

Course Contents

Unit I	Sensors and Actuators in Agriculture	8 Hours

Fundamentals of sensors and actuators used in agricultural systems, **Sensors:** Types of sensors- for measuring Soil parameters (Soil Moisture Sensor eg. Capacitive/YL-69 and Soil pH Sensor eg. SEN0161 / Atlas Scientific pH Kit) , Crop Health (Chlorophyll Sensor eg.SPAD-502 Meter and NDVI Sensor eg. GreenSeeker Handheld Crop Sensor), and environmental conditions(Temperature & Humidity Sensor eg. DHT22 / SHT31), **Actuators:** Mechanized tasks such as irrigation, planting, and spraying. Calibration and maintenance of sensors and actuators in agricultural applications.

#Exemplar/Case Studies: Smart Vineyard Irrigation & Spraying - Nashik (noted for grapes/onion) has varied soils from sandy-loam to black cotton and a pronounced monsoon. Vineyards in Dindori/Sinnar see water-stress swings and downy mildew risk—ideal for sensor-driven control.

*Mapping of Course Outcomes	CO1

Unit II	IoT in Agriculture	7 Hours

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IoT concepts and applications in plant and device control, Applications of IoT in Agriculture: Greenhouse Automation, Agricultural Drones, Monitoring Climate Conditions, Smart Pest Control, Farm Management, Livestock Tracking and Geofencing, Advantages of IoT in Agriculture, Factors to Consider Before Building Your Smart Agriculture Solution, Cloud-based platforms for data management and remote control. Data acquisition methods for collecting agricultural data.		
#Exemplar/Case Studies: IoT-based drip irrigation system in Nashik grape farms.		
***Mapping of Course Outcomes**	**CO2**	
Unit III	**Drone and Robotics in Agriculture**	**8 Hours**
Introduction of drones, types of drones, Importance of drones in modern farming, Identifying plant stress, diseases, and pests using drones, Robotic arms and grippers for manipulation of agricultural objects, Automation of tasks such as harvesting, pruning, and planting.		
#Exemplar/Case Studies: Smart AgroTech Farm – Integrating Drones and Robotics in Precision Farming.		
***Mapping of Course Outcomes**	**CO3**	
Unit IV	**Automated Agriculture Equipments**	**7 Hours**
Automated Tractors, Robotic Harvesters, Solar-powered equipment (Solar powered pump), Automated planters, Robotic weeder, precision sprayers, automatic irrigation system, greenhouse automation, milking machine, animal feeder.		
#Exemplar/Case Studies	Study of Automated Drip Irrigation System for Horticulture.	
***Mapping of Course Outcomes**	**CO4**	

Learning Resources

Text Books

T1. Nitaigour Premchand Mahadik, Mechatronics, Tata Mcgraw-Hill Publishing Company LTD, 2003
T2. G.D.Rai,Solar Energy Utilisation , PHI Publication.

Reference Books :

R1. Dimitrios Moshou, Sensors in Agriculture.
R2. Qin Zhang, Precision Agriculture technology for Crop Farming.
R3. Vijay Medisetti and Arshdeep Bahga, Internet of things.
R4. Dr.Omkar Gupta, Precision Agriculture with Drones, KhannaPublication.
R5. Parth Bhatia & Aditya Agarwal, Automation in Agriculture, Astral International Pvt. Limited, 2025.

Additional Resources: (Books, e-Resources)

- https://www.sciencedirect.com/science/article/abs/pii/S2542660520300044
- Use of Modern Technology in Agriculture Sector https://share.google/1rpi86FLr3PavzGTu
- IoT in Agriculture: https://www.rishabhsoft.com/blog/iot-in-agriculture-industry
- icarreport-2024.pdf https://share.google/ICyRg1TunqbX53VAJ
- https://books.google.co.in/books?id=HW-pEAAAQBAJ&lpg=PR1&pg=PA7#v=onepage&q&f=false
- https://ieeexplore.ieee.org/document/6554005/references#references

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- https://books.google.co.in/books?id=48tNl8L1awkC&lpg=PR1&pg=PR12#v=onepage&q&f=false
- https://openknowledge.fao.org/server/api/core/bitstreams/52160f7e-6106-41d1-b170-fb230a4e7071/content

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24-OEC-3-5-02: Digital Marketing for Agriculture

Teaching Scheme:	**Credit:** 2	**Examination Scheme:**
Theory: 2 Hours/Week		**CIE** : 20 Marks **SEE** : 30 Marks **Total:** 50 Marks

Prerequisites Courses: NA

Companion Course: NA

Course Objectives:

- To Understand Agriculture Marketing Evolution from Traditional to Digital.
- To Learn and understand the digital marketing tools used for optimization and effective marketing strategies in agriculture.
- To Utilize Marketing Channels for agri-business promotion.
- To Explore Recent Technologies and tools.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
CO1	**Design and Execute** Digital Marketing Strategies for Agriculture.	3
CO2	**Apply** Content Marketing Strategies and SEO Techniques.	3
CO3	**Demonstrate** various Social Media Marketing Channels.	3
CO4	**Explore** various Emerging Trends in Digital Marketing and Tools.	3

Course Contents

Unit I	Digital Marketing Essential	7 Hours

Evolution of Agriculture: Traditional vs Modern Marketing, Distribution Channel of Marketing, 7 Ps of Marketing, Agribusiness marketing environment, market segmentation, targeting and positioning, **Digital Marketing:** Fundamental, Process, Tool, Techniques, Terms.

#Exemplar/Case Studies - Organic Farm Business (Sahyadri Farms)

*Mapping of Course Outcomes	CO1

Unit II	Content Marketing and SEO	8 Hours

Content Marketing: Developing a content marketing strategy, Creating compelling and engaging content, Blogging best practices and SEO for content, Content distribution, **SEO:** Websites, Keyword research, on-page optimization, Off-page optimization, link building strategies, website performance optimization, Pay-per-Click Advertising (PPC).

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#Exemplar/Case Studies - Agrofresh Startup Pune.		
***Mapping of Course Outcomes**	**CO2**	
Unit-III	**Social Media Marketing**	**7 Hours**
Channels: Facebook, Instagram, Twitter, LinkedIn, Creating a social media strategy and content planning, Social media advertising and targeting options, Influencer marketing and community management.		
#Exemplar/Case Studies - Farm Fresh Vegetable by Kissankonnect Mumbai.		
***Mapping of Course Outcomes**	**CO3**	
Unit-IV	**Emerging Trends in Digital Marketing and Tool**	**8 Hours**
Emerging Trends: AR/VR Marketing, Voice Search Optimization, AI-driven content creation **Tool:** Google Analytics, SEMrush, GoogleAds **AI Tool :** Replo (Page Builder) , Copy.ai (Content Creation)		
#Exemplar/Case Studies - Smart Farming with Fasal An Indian Agriteh Startup		
***Mapping of Course Outcomes**	**CO4**	
Learning Resources		
Text Books		
T1. Dodson, I. (2016). The art of digital marketing: the definitive guide to creating strategic, targeted, and measurable online campaigns. John Wiley & Sons. First published:3 February 2016, Print ISBN: 9781119265702 **T2.** Kartajaya, H., Kotler, P., & Setiawan, I. (2016). Marketing 4.0: moving from traditional to digital. John Wiley & Sons.		
Reference Books :		
R1. Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing by Dave Chafey and PR Smith Publisher –Routledge; 5th edition 24 March 2017 **R2**. Seema Gupta: Digital Marketing: Mcgraw Hill, 3rd Edition 2023.		
Additional Resources: (Books, e-Resources) • https://digitalmarketinginstitute.com/resources/ebooks • https://www.digitalmarketer.com/digital-marketing/assets/pdf/ultimate-guide-to-digital-marketing.pdf?srsltid=AfmBOorjpArgkEjkxKYrUhLHUDw3liuMuSIJNl-Re5rj0YGMN9_mrS_ • https://www.emarketinginstitute.org/ebook-content-marketing-for-beginners/?success=190536 • https://digitalscholar.in/digital-marketing-ebooks/		
MOOC Courses links : • https://onlinecourses.swayam2.ac.in/ugc19_hs26/preview • https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/269 • https://www.futurelearn.com/courses/digital-marketing • https://www.coursera.org/specializations/digital-marketing		

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24-OEC-3-5-03: Estimating and Costing

Teaching Scheme: Theory: 2 Hours/Week	**Credit:** 2	**Examination Scheme:** **CIE** : 20 Marks **SEE** : 30 Marks

Prerequisite Courses: NA

Companion Course: NA

Course Objectives:

- Introduce estimation techniques for engineering products, systems, software and services.
- Explain procurement, tendering, contracting and SLA (Service Level Agreement) fundamentals used in industry.
- Teach rate analysis, BOQ (Bill of Quantities) / BOM (Bill of Materials) preparation and spreadsheet-based costing.
- Explain valuation, depreciation, TCO (Total Cost of Ownership) and lifecycle economic decisions.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Identify** and prepare types of estimates and quantity take-offs.	2
CO2	**Illustrate** procurement routes, tendering processes and basic contract clauses.	2
CO3	**Perform** rate analysis and prepare BOQ (Bill of Quantities) / BOM (Bill of Materials) and basic cost sheets.	3
CO4	**Analyze** depreciation, TCO (Total Cost of Ownership) and valuation.	4

Course Contents

Unit I	**Foundations of Estimation**	**8 Hours**

Purpose and scope of estimation in engineering, types of estimates: approximate, preliminary, detailed, budgetary, life-cycle estimates, sources of data: vendor quotations, catalogues, erp (enterprise resource planning), past projects, quantity take-off formats – BoQ (bill of quantities), BoM (bill of materials), BoP (bill of process), cost-influencing factors and common estimation errors

#Exemplar/Case Studies: Prepare an approximate estimate for a mixed lab setup (team) — deliver BoQ & brief assumptions.

***Mapping of Course Outcomes**	**CO1**

Unit II	**Tendering and Contracting**	**7 Hours**

Types of tenders: open, limited, rate contract, e-tendering (electronic tendering), evaluation methods: l1 (lowest bidder), QCBS

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(quality and cost based selection), contract types: lump-sum, item-rate, T&M (time and material), AMC (annual maintenance contract), SLA-based (service level agreement based), key clauses: scope, payment terms, warranty, LD (liquidated damages), penalty, introduction to arbitration and dispute resolution (overview only)		
#Exemplar/Case Studies: Draft a simple tender document & evaluate two mock bids.		
***Mapping of Course Outcomes**	**CO2**	
Unit III	**Quantity Take-off, Specifications & Rate Analysis**	**8 Hours**
Preparing BoQ (bill of quantities), BoM (bill of materials), BoP (bill of process), writing technical specifications (performance, tolerance, acceptance tests), elements of rate analysis: direct material cost, direct labour cost, machine hour rate, tooling, testing, energy cost, software license cost, overheads, costing through spreadsheets (microsoft Excel / google Sheets)		
#Exemplar/Case Studies: Perform rate analysis for a selected hardware / embedded / software / AI process and prepare a cost sheet.		
***Mapping of Course Outcomes**	**CO3**	
Unit IV	**Valuation and Depreciation**	**7 Hours**
Difference between price, cost and value, depreciation methods: SLM (straight line method), WDV (written down value), machine-hour method, sinking-fund method, obsolescence and upgrade cycles, TCO (total cost of ownership), LCC (life cycle costing), BEP (break-even point), make vs buy decision, basic project budgeting and cost comparison		
#Exemplar/Case Studies: Life-cycle cost comparison: On-premise server vs Cloud deployment / CNC machine vs outsourced machining.		
***Mapping of Course Outcomes**	**CO4**	
Learning Resources		
Text Books		
T1. B. P. Sinha, "Mechanical Estimating and Costing", Tata McGraw-Hill, latest edition, ISBN 9780074624111 **T2.** Leland Blank and Anthony Tarquin, "Engineering Economy", McGraw-Hill Education, 7th Edition, ISBN 9780073376301		
Reference Books :		
R1. M.N. Arora, **"**Cost Accounting: Principles and Practice", Vikas Publishing House, 13th edition, ISBN 9354530265 **R2.** R. Panneerselvam , "Production and Operation Management", PHI Learning, 3rd edition, ISBN 9788120345553		
Additional Resources: (Books, e-Resources)		
MOOC Courses links : • https://onlinecourses.nptel.ac.in/noc20_mg53/preview • https://onlinecourses.nptel.ac.in/noc25_me98/preview		

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24-OEC-3-5-04 : Sustainable Energy Engineering

Teaching Scheme: Theory: 02 Hours/Week	**Credit:** 02 **Lectures:** 30	**Examination Scheme:** **CIE** : 20 Marks **SEE :** 30 Marks

Prerequisites Courses: NA

Companion Course: NA

Course Objectives:

- To study sustainable energy systems, access challenges, and their role in achieving SDGs.
- To assess biomass, solar, and geothermal energy systems for their environmental sustainability.
- To explain the principles of tidal and wind energy conversion systems.
- To assess sustainable energy solutions for their potential to promote equitable access.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Understand** the role of Sustainable Development Goals (SDGs) in promoting clean energy.	2
CO2	**Apply** fundamental concepts to assess biomass, solar, and geothermal energy resources and their suitable conversion technologies.	3
CO3	**Understand** the principles, economic prospects, and sustainability aspects of tidal and wind energy systems.	2
CO4	**Apply** lifecycle analysis and circular economy principles to evaluate sustainable energy solutions and emerging clean technologies for equitable access.	3

Course Contents

Unit I	**Sustainable Energy Systems**	**7 Hours**

Sustainability Concepts: Sustainable Development Goals for Clean Energy (SDGS), Emerging Issues in Energy Access, Technologies, Economics. Sustainability Concepts of Energy Generation Technologies, Energy and Resource Utilization.

#Exemplar/Case Studies:

1. Narmada Canal Solar Power Project, Gujarat
2. Indian Mega Kitchen

***Mapping of Course Outcomes**	**CO1**

Unit II	**Thermal Photovoltaic & Geothermal Energy**	**8 Hours**

Biomass Energy, Biofuel: Characterization, Biomass Relevance to Energy Production, Properties Relevant to Energy Production, Thermal Conversion, Bioconversion. **Solar Energy:** Resource Assessment, Concentrating Solar Power, Solar Photovoltaic Systems. **Geothermal Energy:** Principles of geothermal energy, types of geothermal power plants (dry steam, flash steam, binary cycle).

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#Exemplar/Case Studies:

1. Saradambika Biomass Power Plant,Chandrapur
2. Geothermal power well, Puga Valley of Ladakh

***Mapping of Course Outcomes**	**CO2**

Unit III	**Tidal Energy and Wind Energy**	**8 Hours**

Tidal Energy: Energy from the Tides and Currents, Economic Prospects, Environmental and Sustainability Considerations. **Wind Energy:** Wind Resources, Wind turbine Machinery and Generating Systems, Wind Power Economics,Measure of Sustainability.

#Exemplar/Case Studies:

1. Brahmanvel wind farm, Dhule
2. Vizhinjam wave energy plant, Thiruvananthapuram, Kerala.

***Mapping of Course Outcomes**	**CO3**

Unit IV	**Global Energy Access & Sustainability**	**7 Hours**

Energy Access & Equity: Global disparities in electrification, Rural electrification challenges. **Sustainability Concepts:**Lifecycle analysis of renewable vs. fossil technologies, Efficient resource utilization and circular economy in energy systems.**Emerging Technologies:**Clean cooking technologies.

#Exemplar/Case Studies:

1. Bosch solar power plant,Nashik
2. EU-Japan Industrial Cooperation for Decarbonization

***Mapping of Course Outcomes**	**CO4**

Learning Resources

Text Books

T1. Tester Jefferson, Sustainable Energy: Choosing Among Options, Hall of India Private Limited, 2006.
T2. Peake Stephen, Renewable Energy Power for Sustainable Future, New Delhi McGraw Hill Education Pvt. Ltd, 2018.
T3. Peake Stephen, Renewable EnergySources and Emerging Technologies, PHI Learning Pvt.Ltd, 2014.

Reference Books :

R1. Rai. G. D., Non-conventional Energy Resources, Khanna Publishers, 2008
R2. Sukhatme S. P, Solar Energy-Principles of Thermal Collection and Storage, Tata McGraw Hill Publishing Company Limited, 2008

MOOC Courses links :
M1. Energy Resources, Economics, and Sustainability, By Prof. Pratham Arora, IIT Roorkee
https://onlinecourses.nptel.ac.in/noc25_hs86/preview
M2. Renewable Energy Technologies,By Dr. M. Seenuvasan, National Institute of Technical Teachers' Training and Research, Chennai
https://onlinecourses.swayam2.ac.in/ntr25_ed119/preview

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24-OEC-3-5-05: Occupational Health and Safety

Teaching Scheme: Theory: 02 Hours/Week	**Credit:** 02	**Examination Scheme:** **CIE**: 20 Marks **SEE**: 30 Marks

Prerequisites Courses:

Companion Course: NA unit 1, Unit II: PPE Elaborate, case study- Bhopal gas strategy Unit III: safety week

Course Objectives:

- To provide students with a fundamental understanding of workplace safety, types of accidents, hazards, risks, and basic safety requirements in engineering industries.
- To enable students to identify workplace hazards, assess risks using structured methods like HIRAC, and understand appropriate safety control measures.
- To develop awareness of occupational health hazards, their impact on workers, and the importance of monitoring and preventing common occupational illnesses.
- To equip students with knowledge of ergonomics, workplace health practices, first aid, and sustainable approaches for maintaining a healthy and safe work environment.

Course Outcomes:

After completion of the course, learners should be able to

CONo	**CO**
CO1	Understand the fundamentals of workplace safety, types of accidents, unsafe acts/conditions, near miss reporting, first aid, and the importance of proactive and reactive approaches to safety.
CO2	Identify workplace hazards, calculate risk levels, classify acceptable/unacceptable risks, and apply risk assessment and control measures using the hierarchy of controls.
CO3	Explain major occupational health hazards and illnesses, their impact on workers and organizations, and the need for workplace health monitoring and medical surveillance.
CO4	Apply workplace health management practices, including ergonomics, workplace improvements, controlling environmental factors (dust, noise, vibration, fumes), and promoting overall worker well-being.

Course Contents

Unit I	**Fundamentals of Safety**	**06 Hours**

Safety: definition, necessity, and importance of safety, safety week
Accidents: types (minor, major), injuries.
Impact of accidents on human life, organizational costs, productivity
Unsafe act , unsafe condition.
Near miss, identification of near miss.
William Heinrich's observation on safety.
Behaviour base safety

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Reactive and proactive approach in safety. Emergency preparedness **First Aid at Workplace:** basics of handling cuts, burns, fractures, electrical shock, and medical emergencies		
#Exemplar/Case Studies:- NTPC Unchahar Boiler Blast (Uttar Pradesh, 2017)		
***Mapping of Course Outcomes**	CO1	
Unit II	**Workplace Safety Practices**	**06 Hours**
Hazard : Definition, type, identification. Risk: Risk calculation, acceptable and non acceptable risk **Risks identification:** introduction , types and examples **Risk Assessment:**importance for prevention, qualitative and quantitative methods **Control Measures**: hierarchy of controls (elimination, substitution, engineering controls, administrative controls, PPE) **PPE**-Importance of PPE in terms of safety, types & application Introduction of work permit		
#Exemplar/Case Studies:- Bhopal Gas Tragedy (1984)		
***Mapping of Course Outcomes**	CO2	
Unit III	**Fundamentals of Occupational Health**	**06 Hours**
Introduction to Occupational Health: definition, objectives, and relevance in industries Common occupational illnesses: hearing loss, respiratory problems, skin diseases, musculoskeletal disorders, stress-related disorders Effects of poor occupational health on productivity, absenteeism, and quality of life **Workplace health monitoring:** health check-ups, reporting systems, medical surveillance		
#Exemplar/Case Studies-Silicosis Among Rajasthan Mine Workers		
***Mapping of Course Outcomes**	CO3	
Unit IV	**Workplace Health Management and Sustainability**	**06 Hours**
Ergonomics at workplace: Definition, importance , stretching , bending , twisting, lifting , conditions at workplace, ergonomical consideration for avoiding or reducing such conditions **Workplace improvement:** fatigue reduction, occupational unhealthy conditions, dust, fume, vibration, noise, temperature, ventilation, light, measures on unhealthy conditions.		
#Exemplar/Case Studies: Infosys Ergonomic & Wellness Initiatives.		
***Mapping of Course Outcomes**	CO4	
Learning Resources		
Text Books:		
T1. Goetsch D.L., "Occupational Safety and Health for Technologists", Engineers and Managers, Prentice Hall, 1999. **T2.** Heinrich H.W., "Industrial Accident Prevention-A Scientific Approach", McGraw-Hill Book Company, 2007.		

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Reference Books :
R1. Colling D.A., "Industrial Safety Management and Technology", Prentice Hall, 1990. **R2.** Della D.E. and Giustina Van Nostrand Reinhold, "Safety and Environmental Management", 1st Edition, 1996.
Additional Resources: (Books, e-Resources)-1. THE OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE, 2019 https://labour.gov.in/sites/default/files/186_2019_ls_eng_0.pdf 2. Ministry of Labour and Employment https://labour.gov.in/policies/safety-health-and-environment-work-place
MOOC Courses links : ● Certificate in Occupational Health and Safety_ https://www.udemy.com/course/certificate-in-occupational-health-and-safety/?couponCode=25BBPMXNVD35CTRL

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Curriculum and Evaluation Scheme

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2026-27)

Open Elective Syllabus for SEM VI

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24-OEC-3-6-01 E-Governance in Agriculture

Teaching Scheme: Theory: 3 Hours/Week	**Credit:** 03	**Examination Scheme:** **CIE** : 20 Marks **MSE :** 20 Marks **SEE** : 60 Marks

Prerequisites Courses: 24-OEC-2-4-01 Precision Agriculture

Companion Course: NA

Course Objectives:

- **Introduce** the concept of e-Governance in agriculture.
- **Study** government initiatives like NeGPA, Soil Health Card, and MahaDBT schemes.
- **Explore** the use of ICT tools, digital platforms, and project management in agriculture services.
- **Learn** agricultural policies, case studies, and future digital trends in e-Governance.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Understand** the concept of e-Governance in agriculture.	2
CO2	**Illustrate** NeGPA and related frameworks for agricultural e-Governance.	2
CO3	**Apply** project management concepts for e-Governance systems.	3
CO4	**Analyze** the importance of capacity building NeGPA.	4
CO5	**Apply** ICT tools and schemes in agricultural practices.	3
CO6	**Analyze** national and international case studies to suggest practical improvements.	4

Course Contents

Unit 1	**Basics Of E-Governance**	**7 Hours**

E-Governance - Evolution, Definition, Benefits & Limitations, Components of e-Governance, Farmer Services (G2C,G2G,G2B,G2E,G2S) , Role of E-Governance in Agriculture.

#Exemplar/Case Studies : Study of Digital Land Records: (MahaBhulekh)

***Mapping of Course Outcomes**	**CO1**

Unit 2	**E-Governance Initiatives : NeGPA**	**7 Hours**

Introduction to NeGPA (National e-Governance Plan in Agriculture). NeGPA vision. The framework for e- Governance, National e-Governance strategy . Major Components of National e-Governance Plan, Mission Mode Projects, Infrastructure pillars of NeGPA,Capacity Building initiatives under NeGPA.

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#Exemplar/Case Studies: Study of Mizoram e-Governance initiatives in Agriculture.		
***Mapping of Course Outcomes**	**CO2, CO6**	
Unit 3	**E-Governance Project Development And Management**	**7 Hours**
Introduction to eGovernment Project Development , Phases of e-Government Project Development: Conceptualization, Architect, Define, Support, e-Government Project Management, Business Model for e-Government Projects .		
#Exemplar/Case Studies : Study various Agro e-Governance Projects in India.		
***Mapping of Course Outcomes**	**CO3, CO4**	
Unit 4	**Ict Tools In Agriculture**	**7 Hours**
Introduction to ICT tools in agriculture, use of ICT tools in agriculture, Unified Farmer Service Platform(UFSP) Digital tools in agriculture: advisory apps, remote sensing, weather alerts, Tools: mKisan, e-Krishi, Kisan Call Centres; GPS and mobile-based services for farmers.		
#Exemplar/Case Studies: mKisan Portal.		
***Mapping of Course Outcomes**	**CO5**	
Unit 5	**Agricultural Policies**	**7 Hours**
Key Indian government policies:Digital India initiative, Pradhan Mantri Kisan Samman Nidhi (PM-KISAN), Pradhan Mantri Fasal Bima Yojana (Crop Insurance Scheme), AgriStack platform; Soil Health Card Scheme: Objectives, benefits; implementation process.		
#Exemplar/Case Studies: Soil Health Card (Maharashtra)		
***Mapping of Course Outcomes**	**CO5,CO6**	
Unit 6	**MahaDBT Schemes And Future Trends**	**7 hours**
Introduction to MahaDBT (Maharashtra Direct Benefit Transfer) portal; Overview of MahaDBT Agricultural Schemes:Subsidy for Drip Irrigation, Pump Sets, Sheti Vikas Yojana (Farm Development Scheme), Organic Farming Promotion Scheme,Horticulture: e-pickapani, Future: IoT in e-Governance.		
#Exemplar/Case Studies: Discussion on MahaAgri AI.		
***Mapping of Course Outcomes**	**CO5,CO6**	
Learning Resources		
Text Books		
Recommended Books: **T1**. C.S.R.Prabhu : E-Governance: Concepts and Case Studies, Prentice Hall of India Pvt. Limited (2004). **T2**.Backus, Michiel: E-Governance in Developing Countries, IICD Research Brief, No. 1 (2001).		
Reference Books :		

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R1. Michiel Backus, *E-Governance in Developing Countries*, IICD Research Brief
Additional Resources: (Books, e-Resources) **unit 11 blk 3** NeGP (National e-Governance Plan) eGovernment Project Development **MahaDBT Portal** **Mizoram ICT Department**
MOOC Courses links : NA

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24-OEC-3-6-02: Agri Entrepreneurship

Teaching Scheme: Theory: 3 Hours/Week	**Credit:** 3	**Examination Scheme:** **CIE** : 20 Marks **MSE :** 20 Marks **SEE** : 60 Marks

Prerequisites Courses: 24-EEM-2-01: Engineering Economics, 24-EEM-2-02: Entrepreneurship Development

Companion Course: - NA

Course Objectives:

- To introduce students to agri based industries and business opportunities.
- To enable students to identify technology driven agri business models.
- To develop entrepreneurial thinking focused on rural and agriculture development.
- To promote interdisciplinary collaboration to solve agri-sector problems

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1.	**Understand** the role of technology and engineering in improving agriculture and allied practices.	2
CO2.	**Apply** engineering knowledge to identify business opportunities in agricultural mechanization, irrigation, and processing.	3
CO3.	**Apply** ICT, renewable energy, and smart tools to propose innovative agri business solutions.	3
CO4.	**Apply** appropriate methods to identify challenges, advantages, and limitations of technology based entrepreneurship in agriculture.	3

Course Contents

Unit I	**Agricultural Engineering and Mechanization**	**6 Hours**

Introduction to Agricultural Mechanization: Role of mechanization in increasing productivity, reduction in manual work, scope for engineering solutions. **Farm Machinery & Implements**: Business scope in developing low-cost machinery, automation tools, and retrofitting existing equipment. **Precision Agriculture Tools**: GPS guided equipment, soil sensors. **Custom Hiring Centers**:Concept, business model, technical and financial feasibility.

Exemplar/Case Studies: Study of Custom Hiring Centers

Mapping of Course Outcomes	**CO1, CO2, CO3, CO4**

Unit II	**Soil and Water Management**	**6 Hours**

Micro-Irrigation Systems: Introduction to drip and sprinkler system design and installation, business opportunities for local startups. **Water Harvesting and Watershed Management**: Small scale entrepreneurial models in rural areas. **Soil Testing and**

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Fertility Management: Technology based soil testing kits, Soil restoration, scope for services and product development. **Irrigation Automation**: Smart irrigation system, application, advantages, and startup potential.		
Exemplar/Case Studies: Study of Irrigation system		
Mapping of Course Outcomes	**CO1, CO2, CO3, CO4**	
Unit III	**Agricultural Processing and Post-Harvest Technology**	**6 Hours**
Agri Processing Technologies: Vegetable dryers, milling, oil extraction, viability and challenges. **Cold Chain and Storage Systems**: Business ideas in logistics, cold storage and value preservation. **Value Addition and Food Packaging**: Engineering innovations in packaging, biodegradable materials, shelf-life enhancers. **Supply Chain Digitization**: Platforms for market linkage, quality traceability, and delivery optimization.		
Exemplar/Case Studies: Study of Mini Dal Mills		
Mapping of Course Outcomes	**CO1, CO2, CO3, CO4**	
Unit IV	**Renewable Energy in Agriculture**	**6 Hours**
Business Opportunity in Solar Power: Solar pumps, dryers, business model for rural deployment. **Biogas and Waste to Energy**: Plant design and commercialization, rural bioenergy entrepreneurship. **Wind and Hybrid Systems**: Feasibility for remote agri lands, pilot projects. **Energy Audits and Management in Farms**: Scope for consultancy services and IoT-based monitoring.		
Exemplar/Case Studies: Study of Solar Pump/Dryer		
Mapping of Course Outcomes	**CO1, CO2, CO3, CO4**	
Unit V	**Business Opportunities in Agri ICT and Smart Farming**	**6 Hours**
IoT in Agriculture: Sensors, data loggers, mobile apps, product and service based startups. **GIS and Remote Sensing**: Business scope in land mapping, crop monitoring and advisory. **Farm Management Software**: ERP tools, mobile dashboards, SaaS model (Software as a Service) for agri entrepreneurs. **AI/ML in Crop Disease Detection and Yield Prediction**: Data driven decision making platforms.		
Exemplar/Case Studies: Sahyadri Farm Nashik		
Mapping of Course Outcomes	**CO1, CO2, CO3, CO4**	
Unit VI	**Agri Business Incubation and Entrepreneurship**	**6 Hours**
Business Model Canvas for Agri Startups: Problem identification to solution development. **Policy Support & Government Schemes**: NABARD, Agri Clinics, Startup India, leveraging funding and support. **Challenges and Risk Management in Agri-Entrepreneurship**: Limitation, analysis and contingency planning.		
Exemplar/Case Studies: Study of Successful Agritech Startup		
Mapping of Course Outcomes	**CO1, CO2, CO3, CO4**	
Learning Resources		
Text Books		

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T1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha, Entrepreneurship, Mc-Graw Hill International Editions, 11th Edition, 2005
T2. David Oates, A guide to entrepreneurship includes Case Studies, Jaico Publishing House.2008.

Reference Books :

R1. Holt David H, Entrepreneurship-A New Venture Creation, PHI Learning Private Limited. 2010.
R2. Charanthimath poornima, Entrepreneurship Development and Small Business Enterprises, Pearson Education India.2014.

Additional e-Resources:

- Food and Agri Org (FAO) Agricultural Engineering Portal: www.fao.org/agriculture/engineering
- NABARD & ICAR soil testing manuals: www.nabard.org
- Ministry of New & Renewable Energy, India: www.mnre.gov.in
- NABARD, Agri-Clinics, Startup India portal: www.startupindia.gov.in
- MarketResearchReports :https://www.startupindia.gov.in/content/sih/en/resources/market-research
- Prabhaav - 9-Year Factbook: https://www.startupindia.gov.in/content/sih/en/Prabhaav
- ICAR Success Stories: https://icar.org.in/en/success-stories
- NABARD's annual reports: https://www.nabard.org/financialreport
- NABARD's research studies https://www.nabard.org/about-departments
- Good Practices in Agricultural Extension and Advisory Services: https://www.manage.gov.in/publications/goodpractices/MANAGE-Good-Practices

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24-OEC-3-6-03 : Innovation Entrepreneur and Venture Development

Teaching Scheme: Theory: 3 Hours/Week	**Credit:** 3	**Evaluation Scheme:** **CIE:** 20 Marks **MSE**: 20 Marks **SEE**: 60 Marks

Prerequisite Courses: – 24-EEM-2-01 Engineering Economics, 24-EEM-2-02 Entrepreneurship Development

Companion Course: – NA

Course Objectives:

- To understand the core concepts of innovation and entrepreneurship and their role in the economic development of society and nation.
- To demonstrate a systematic approach to identifying and validating market opportunities using problem-solving and ideation frameworks.
- To apply strategic models for designing a new venture, from developing a business model to defining a Go-to-Market strategy.
- To gain knowledge of entrepreneurial finance and resource management, including different funding sources, risk analysis, and financial planning.
- To examine the importance of intellectual property and technology adoption in protecting and scaling a venture.
- To explore emerging trends in technology and business models to identify opportunities for sustainable and future-ready solutions.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Understand** the fundamental concepts of innovation and entrepreneurship and their role in development.	2
CO2	**Demonstrate** a structured approach to problem identification and idea generation using tools like Design Thinking, SWOT, and Pugh's Method.	2
CO3	**Apply** the principles of the Lean Canvas and Go-to-Market strategy to formulate a new venture strategic plan.	3
CO4	**Utilize** key concepts of entrepreneurial finance, including funding sources, financial projections, and risk management, for a business plan.	3
CO5	**Summarize** the role of Intellectual Property Rights and Technology Adoption in protecting and growing an innovative venture.	2
CO6	**Describe** the current and future trends in business and technology and their implications for sustainable entrepreneurial solutions.	2

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Course Contents		
Unit I	**Innovation Entrepreneur**	**8 Hours**
Concept of Innovation Entrepreneur, **Types of Innovation** – Incremental, Disruptive, Process, and Product Innovation, **Need and Significance of Innovation** in Economic Development of a venture to gain a competitive advantage and ensure sustained growth, **Evolution of Entrepreneurship** – From Traditional Business to Startups, **Key Differences** between Entrepreneur, Intrapreneur, and Technopreneur, **Entrepreneurial Mindset**: Core Business Strategies of Indian Business Systems, **Barriers and Challenges** to Innovative Entrepreneurship		
#Exemplar/Case Studies: Blinkit (case study is a good example of rapid, disruptive innovation and scaling in the Indian market)		
Mapping of Course Outcomes	CO1	
Unit II	**Design Thinking**	**8 Hours**
Problem vs. Opportunity: Tools and Techniques to identify a real problem and validate it as an opportunity. **Design Thinking Principles**: A hands-on approach to problem-solving and innovation. **Idea Generation Approaches**: Theory of Inventive Problem Solving (TRIZ), Brainstorming, Alternate Thinking, and Reverse Engineering. **Product Policy & Concept Selection:** SWOC Analysis, Pugh's Method, Selection of Profitable Concept. **Concept Analysis:** Marketing Aspects, Product Characteristics (Functional, Operational, Durability, Aesthetic, Ergonomic), and **Economic & Production Aspects**. **Functional Modelling:** FAST, Subtract & Operate Procedure.		
#Exemplar/Case Studies: SCAMPER approach to challenges faced by students with their daily commute wrt time, cost, convenience, etc..		
Mapping of Course Outcomes	CO2	
Unit III	**Business Model and Innovation Protection**	**7 Hours**
Lean Canvas vs. Business Model Canvas: Key differences, Understanding the key components of Lean Canvas for a Startup, **Technology Adoption and Diffusion:** Rogers' Diffusion of Innovations Theory, **Protecting Innovation:** Intellectual Property Rights (Patents, Copyrights, Trademarks, Design Rights), **Licensing & Technology Transfer, Commercialising Patents**		
#Exemplar/Case Studies: Dyson's Patents in Vacuum Cleaner Technology		
Mapping of Course Outcomes	CO3	
Unit IV	**Venture Development**	**8 Hours**
Introduction to Venture Development: Process from concept to execution, **Indian Market Trends**: Consumer behavior in India vs. Global consumer behavior. Competitor Analysis: **Go-to-Market Strategy:** Customer Segmentation, Targeting, Positioning (Unique Value Proposition and Unfair Advantage), Marketing and Sales Channels,**Key Performance Indicators (KPIs):** customer acquisition cost, churn rate, lifetime value, EBITDA, **Scaling & Sustainability** in Ventures, **Challenges** in Venture Development		
#Exemplar/Case Studies: D - mart for Unique Value Proposition and Unfair Advantage over Big Bazaar **Skippi Ice Pops** - masterclass in pitching, backed their claims with solid numbers, marking the first "all-shark deal" in Shark Tank India		
Mapping of Course Outcomes	CO4	

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Unit V	Entrepreneurial Finance	7 Hours
Sources of Finance: Bootstrapping, Angel Investors, Venture Capital, and Crowdfunding, **Effective Pitch Deck, Resource Management**: Planning for Human, Technological, and Physical Resources. Financial Sustainability in **Social Startups**, **Financial Projections**: Key metrics and forecasting for entrepreneurs, **Risk Analysis and Management**: Identifying and mitigating financial and operational risks.		
#Exemplar/Case Studies: Pebble (crowdfunding and then failure) vs Zomato (initial failures and then bootstrapping to a massive IPO)		
Mapping of Course Outcomes	CO5	
Unit VI	**Emerging Trends**	**7 Hours**
Sustainable Innovation: Green Entrepreneurship, Circular Economy & Waste-to-Value Models **Digital Transformation in Startups:** AI, IoT, Blockchain Applications **Deep Tech & Emerging Industries:** Biotech, Space Tech, AR/VR **Future of Entrepreneurship:** Gig Economy & Platform-based Business Models		
#Exemplar/Case Studies: Zomato / NinjaCart		
Mapping of Course Outcomes	CO6	

Learning Resources

Text Books:

T1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, "Entrepreneurship", McGraw-Hill Education, 2023, Edition 10, ISBN 1265332258, 9781265332259.
T2. Donald F. Kuratko, "Entrepreneurship: Theory, Process, Practice", Cengage Learning, 2019, Edition 11, ISBN 0357033892, 9780357033890.
T3. Ajay Batra, "Breeding Innovation and Intellectual Capital", Shroff Publishers Distributors, 2009, Edition 2, ISBN 8184047886, 9788184047882.

Reference Books:

R1. Thomas H. Byers, Richard C. Dorf, Andrew J. Nelson, "Technology Ventures: From Idea to Enterprise", McGraw-Hill Education, 2018 (5th Edition), ISBN 1259875997, 9781259875991.
R2. Peter F. Drucker, "Innovation and Entrepreneurship", Harper Business (Reprint), 2006, ISBN 0060851139, 9780060851132.

Additional Resources: (Books, e-Resources)

1. Blank S. – The Startup Owner's Manual, K&S Ranch.
2. https://www.startupindia.gov.in (https://www.startupindia.gov.in)

MOOC Courses links / other :

- Entrepreneurship and Start-ups - Dr. P. Jakulin Divya Mary https://onlinecourses.swayam2.ac.in/ntr25_ed60/preview

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24-OEC-3-6-04: Rural Finance Management and Budgeting

Teaching Scheme: Theory: 3 Hours/Week	**Credit:** 3	**Examination Scheme:** **CIE** : 20 Marks **MSE :** 20 Marks **SEE** : 60 Marks

Prerequisites Courses: NA

Companion Course: NA

Course Objectives:

- To provide students with a clear understanding of the principles, concepts, types, and importance of rural credit, along with measures taken to improve credit flow in agriculture.
- To explain the meaning, nature, and scope of microfinance, and to highlight its role in promoting socio-economic development through self-help groups and community initiatives.
- To familiarize students with the structure, functions, and roles of key rural financing institutions, including RBI, RRBs, NABARD, and cooperative credit societies, and their contribution to rural development.
- To develop practical knowledge of budgeting and financial planning techniques applicable to rural enterprises and development projects.
- To enable students to demonstrate financial decision-making for simple rural project situations, ensuring sustainability and effective resource utilization.
- To provide an understanding of government schemes, digital finance, and fintech applications, emphasizing their role in promoting financial inclusion in rural areas.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
1	**Understand** the principles, concepts, and importance of rural finance in India.	2
2	**Analyze** the role and functions of microfinance and self-help groups in rural development.	4
3	**Illustrate** the role and functions of RBI, RRBs, NABARD, and cooperative credit societies in rural development.	2
4	**Apply** budgeting and financial planning techniques to rural enterprises and projects.	3
5	**Highlight** the process, planning approaches, and implementation mechanisms related to rural finance.	2
6	**Understand** government schemes, digital finance, and fintech applications in rural financial inclusion.	2

Course Contents

Unit I	**Basics of Rural Finance**	**8 Hours**

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History and background of rural finance in India, concepts and characteristics of rural credit, financial needs of rural enterprises, challenges of rural credit in India, steps to enhance rural credit availability, and importance of rural credit in India.		
#Exemplar/Case Studies: To study Impact of the Kisan Credit Card Scheme on Farmers .		
***Mapping of Course Outcomes**	**CO1**	
Unit II	**Microfinance**	**7 Hours**
Meaning, nature, and scope of micro-credit and microfinance, characteristics and distinctive features of microfinance, role of microfinance in socio-economic development, challenges of microfinance in India, and significance of self-help groups.		
#Exemplar/Case Studies: Discuss the Microfinance initiatives by Bandhan Bank/Yes Bank. or any such bank.		
***Mapping of Course Outcomes**	**CO2**	
Unit III	**Rural Financing and Credit Institution**	**8 Hours**
Introduction to Rural Financing,Institutional structure of rural financing in India, role of RBI, RRBs, NABARD, the Maharashtra State Co-operative Bank, microfinance institutions (MFIs), and co-operative credit societies in rural development.		
#Exemplar/Case Studies: Identify challenges such as loan recovery issues, governance problems, NPAs, of District Central Cooperative Banks (DCCBs) in rural development.		
***Mapping of Course Outcomes**	**CO2, CO3**	
Unit IV	**Budgets and Business Budgeting**	**8 Hours**
Meaning, nature, objectives, and types of budgets; preparation of budgets; budget coordination; essentials of effective budgeting; importance of budgeting in rural projects; and zero-based budgeting (ZBB) in rural development.		
#Exemplar/Case Studies : Highlight the importance of budgeting in ensuring sustainability and growth of Amul Dairy .		
***Mapping of Course Outcomes**	**CO4**	
Unit V	**Rural Project Financial Planning**	**7 Hours**
Introduction to Project Financial Planning, Sources of Project Funding,Budgeting for Sustainability,Process, Planning, and Implementation of Rural Finance.		
#Exemplar/Case Studies: To create a financial plan for Rural Waste-to-Energy Projects		
***Mapping of Course Outcomes**	**CO4, CO5**	
Unit VI	**Government Schemes & Policy Framework**	**7 Hours**
Overview of financial inclusion policies, priority sector lending norms, rural development schemes (PM-KISAN, MGNREGA, PMFBY, etc.), and digital finance and fintech applications in rural areas.		
#Exemplar/Case Studies: Examine the Role of Paytm Payments Bank in Promoting Digital Financial Inclusion in Rural India		
***Mapping of Course Outcomes**	**CO6**	

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Learning Resources
Text Books
T1. Malcolm Harper, "Practical Microfinance – A Training Guide for South Asia", Vistaar Publications (Sage India), 2003, Edition 1, ISBN 8178292882. **T2.** Agarwal, Vijay, Surolia, Business Budgeting.RBD Publication Jaipur Business Budgeting 13 Edition 2021-22. **T3.** Narasimhan Srinivasan, "State of Rural Finance in India: An Assessment", Oxford University Press, New Delhi, 2016, Edition 1, ISBN 0199464847 **T4.** Gursharan Singh Kainth, "Managing Rural Finance in India", Concept Publishing Company, New Delhi, 2010, Edition 1, ISBN 818069657X.
Reference Books:
R1. Susan Johnson, Ben Rogaly, "Microfinance and Poverty Reduction", Oxfam (Oxford), 1997, ISBN 0855983698. **R2.** Ravi M. Kishore, "Financial Management", Taxmann Publications, New Delhi , 6th ed. (2007) ISBN 817496925X **R3.** Rais Ahmad (Ed.), "Agriculture, Rural Banking and Micro Finance in India", New Century Publications, ISBN-10 8177083244,
Additional Resources: (Books, e-Resources) ● Bhartiya Arthvyavastha, Ranjan Kolambe, Marathi, Bhagirath Academy. NABARD Annual Reports and Rural Credit Surveys – https://www.nabard.org ● RBI Reports on Priority Sector Lending & Rural Development – https://www.rbi.org.in
MOOC Courses links : ● Sustainable Business Models in Microfinance – Offered by State Bank of India via edX. State-Bank-of-India: Sustainable Business Models in Microfinance https://www.edx.org/learn/sustainability/state-bank-of-india-sustainable-business-models-in-microfinance ● Rural finance course – FAO / RFILC Online Learning Modules. https://www.rfilc.org/learning/rural-finance-course/ ● Money Banking & Financial Markets – SWAYAM (UGC/NPTEL). https://onlinecourses.swayam2.ac.in/imb24_mg51/preview ● Rural Local Governance – SWAYAM https://onlinecourses.swayam2.ac.in/cec24_hs55/preview

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24-OEC-3-6-05: Renewable Energy for Agriculture

Teaching Scheme: Theory: 3 Hours/Week	**Credit:** 3	**Examination Scheme:** **CIE** : 20 Marks **MSE :** 20 Marks **SEE** : 60 Marks

Prerequisites Courses: 24-BSC-1 -01: Engineering Physics, 24-BSC-1-02: Engineering Chemistry, 24-ESC-1- 01: Basic Electrical and Electronics Engineering

Companion Course:

Course Objectives:

- To illustrate the concept of various forms of conventional and renewable energy.
- To outline division aspects and utilization of renewable energy sources for agriculture.
- To analyse the environmental and cost economics of using renewable energy sources compared to fossil fuels.
- To identify the methodologies / technologies for effective utilization of renewable energy for agriculture.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
CO1	**Illustrate** commercial energy and renewable energy sources.	2
CO2	**Elaborate on** the working principles of various renewable energy systems.	2
CO3	**Apply** fundamental concepts to perform basic design of renewable energy systems.	3
CO4	**Outline** renewable energy technologies and compare their working and uses.	2

Course Contents

Unit I	Overview of Energy Resources in Agriculture	07 Hours

Overview, Types of renewable and conventional energy resources, Global energy Scenario, Challenge of climate change, Need for renewable energy, Carbon Credits and Carbon Footprints, India's climate commitments- COP26 target, Role of renewable energy in agriculture.

#Exemplar/Case Studies: India's transition from coal-based electricity to renewable energy mix (NTPC shifting to solar & wind projects).

*Mapping of Course Outcomes	CO1

Unit II	Solar Energy in Agriculture: Basics and Photovoltaic Systems	07 Hours

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Solar Energy: Principles of Solar radiation, Solar radiation -terrestrial and extra-terrestrial, Energy potential of sun, Solar Panel types, Solar Plant, Solar fencing, Solar cells, Li-ion (Lithium-ion) battery storage, Solar Photovoltaic System, Applications of Solar Energy in agriculture sector.		
#Exemplar/Case Studies: Cold storage of mangoes and dairy products in rural villages using off-grid solar PV systems.		
***Mapping of Course Outcomes**	**CO2, CO3**	
Unit III	**Solar Thermal Solutions for Modern Agriculture**	**07 Hours**
Introduction to solar thermal systems, Difference between solar photovoltaic and solar thermal systems, Simple flat plate collector, LFPC (Liquid Flat Plate Collector), Solar dryer, different types of Solar dryer, Solar thermal pump		
#Exemplar/Case Studies : Solar drying of spices (turmeric, chili, and coriander) in rural farming communities.		
***Mapping of Course Outcomes**	**CO2, CO3, CO4**	
Unit IV	**Integration of Biomass in Agricultural Systems**	**07 Hours**
Biomass Sources: crop residues, animal waste, agro-industrial residues, energy crops. **Biomass applications in agriculture:** biomass-based water pumping systems, biomass briquettes and pellets for heating and drying crops, Agriculture waste to charcoal. **Environmental & Economic Aspects :** Biomass for waste management in agriculture.		
#Exemplar/Case Studies : Community Biogas Plant.		
***Mapping of Course Outcomes**	**CO2, CO3**	
Unit V	**Sustainable Agriculture through Wind, Hydro Energy**	**07 Hours**
Wind energy: Wind turbines, Types of turbines, Wind energy conversion system, Water Pumping for Irrigation, Advantages and disadvantages. **Hydro power:** Water turbines, Hydroelectric system theory, Irrigation Pumping, Hydropower dams, Water lifting, Advantages and disadvantages of hydroelectric system.		
#Exemplar/Case Studies: Small farm wind + solar hybrid pump for perennial horticulture (grapes / pomegranates).		
***Mapping of Course Outcomes**	**CO2, CO3, CO4**	
Unit VI	**Integrated Renewable Energy Policies for the Agriculture Sector**	**07 Hours**
Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM Scheme), State-Level Solar Irrigation Initiatives, National Solar Mission (used for renewables-Linked Agricultural and Energy Policies), SEU model		
#Exemplar/Case Studies: National Solar Mission (JNNSM / NSM) — launched to rapidly scale up solar capacity in India and drive cost reductions and diffusion of solar technologies; provides the national policy context that legitimizes and supports schemes like PM-KUSUM.		
***Mapping of Course Outcomes**	**CO1, CO2**	
Learning Resources		

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Text Books
T1.S. P. Sukhatme, Solar Energy, McGraw-Hill Education, Third Edition, 2009 **T2.** John W. Twidell and A.D. Weir, Renewable Energy Source, ELBS Publication **T3.** G.D. Rai, Non-Conventional Energy Sources, Khanna publishers, 2004
Reference Books:
R1. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future", 3rd Edition 2012, Oxford University Press, ISBN: 978-0199681273 **R2.** Joshua Earnest, Wind Power Technology", 2nd Edition, PHI Learning, 2015. **R3.** D. D. Hall and R. P. Overend, Biomass Regenerable Energy", John Wiley, New York, ISBN:047190919X **R4.** B. S. Magal, Solar Energy, Tata Mc-Graw Hill, 2000
Additional Resources: (Books, e-Resources)
MOOC Courses links: ● https://nptel.ac.in/courses/103103206 ● https://nptel.ac.in/courses/103107157

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