

Solid Waste And By-Product Utilization		Semester	III
Course Code	BAG306D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		
<b>Course objectives:</b> <ol style="list-style-type: none"><li>1. Appreciate basic concepts of by-products and waste generation in agricultural production and processing</li><li>2. Utilize the energy from direct combustion of solid waste</li><li>3. To convert solid waste into thermo-chemical and Bio-chemical</li><li>4. To manage the solid waste for bio-utilization</li><li>5. Effluent treatment and disposal of waste</li></ol>			
<b>Teaching-Learning Process (General Instructions)</b> <p>These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"><li>1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Videodemonstrations or Simulations.</li><li>2. Chalk and Talk method for Problem Solving.</li><li>3. Adopt flipped classroom teaching method.</li><li>4. Adopt collaborative (Group Learning) learning in the class.</li><li>5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.</li></ol>			
<b>Module-1</b>			
<b>Introduction to by-products and waste generation in agricultural production and processing:</b> By-products/waste, types of food by-product and waste, magnitude of by-products and waste in food production, magnitude of by-products and wastes in food processing <b>Waste management concepts:</b> Waste characteristics, waste management and effluent treatment			
<b>Module-2</b>			
<b>Direct combustion of solid waste:</b> Proximate and ultimate analysis of biomass, theory of combustion, direct combustion of biomass as fuel in furnaces, operating conditions affecting design of furnace. Bales, operation of baler, briquettes, advantages and uses of briquettes.			
<b>Module-3</b>			
<b>Thermo-chemical conversion of solid waste:</b> Biomass gasification, gasification process mechanism, types of gasifier reactors, utilization of producer gas. <b>Bio-chemical conversion of solid waste:</b> Biogas, biogas plants, classification of biogas plants, design of biogas plants, comparison among KVIC, Janta and Deenbandhu biogas plants, working of Deenbandhu biogas plant. Selection of proper size of biogas plant, utilization of biogas for cooking purpose. Utilization of biogas for lighting purposes and engine operation.			
<b>Module-4</b>			
<b>Solid waste management:</b> Methods of disposal solid waste, Vermin composting Presence of typical chemicals: Microbiology of waste, bacteriological analysis of water, water borne diseases, insecticide, pesticide and fungicides residues. Management of Pesticide Residues, equipment's for estimation of pesticide residue.			
<b>Module-5</b>			

**Effluent treatment and disposal:**

Parameters of effluent like temperature, pH, Oxygen demands (BOD, COD), fat oil and grease content, metal content, forms of phosphorous and sulphur in effluent. Treatment of effluent, steps for waste water treatment, sedimentation, coagulation, flocculation and floatation.

Characteristics of food processing waste water, trickling filters, rotating biological contractors. Oxidation ditches, activated sludge process, lagoons. Filtration, slow sand filter, rapid sand filter, disinfection of water

**Course outcome (Course Skill Set)**

At the end of this course, the student will be able to:

1. Understand the types and formation of by-products and waste, uses of different agricultural by-products.
2. Understand the concept, scope, maintenance of waste management and effluent treatment, Waste water contents and treatments and also familiar with microbiology of waste, ingredients like insecticide, pesticides & fungicides residues.
3. Understand utilization of waste in various industries, biomass as fuel, charcoal briquette, and generation of electricity using surplus biomass and remember producer gas generation.
4. Understand the design consideration of waste treatment and disposal of community & family size biogas plants, vermin-composting and pre-treatment of waste.
5. Familiar with the secondary treatments for food plant wastes, tertiary treatments, effluent treatment plants and environmental performance of food industry.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks



**Suggested Learning Resources:****Books**

1. Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.
2. Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Subtropical fruits and vegetables, AVI Pub. Co.
3. Shewfelt, R.L. and Prussi, S.E. 1992. Post-Harvest Handling – A Systems approach, Academic Press Inc. USDA. 1992. Agricultural Waste Management Field Hand book. USDA, Washington DC.
4. Weichmann J. 1987. Post Harvest Physiology of vegetables, Marcel and Dekker Verlag. V.K. Joshi & S.K. Sharma. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency.
5. Vasso Oreopoulou and Winfried Russ (Edited). 2007. Utilization of By-products and Treatment
6. G.D. Rai Non-Conventional Energy Sources

**Web links and Video Lectures (e-Resources):****Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignments
- Seminars

  
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