

irrigation and protected cultivation; Detection based spraying system using ultrasound for spraying operation using opens source hardware by programming with sensor and testing; Detection based spraying system using ultrasound for spraying operation – installation on sprayer unit with actuator/sensor and testing; Learning on open source image processing software for shape analysis and object detection; Learning about the different applications of robots in agriculture; Fabrication and integration of sensors; Visit to robot fabrication facilities/workshop.

Suggested Readings

1. Bräunl, T. 2013. *Embedded Robotics Mobile Robot Design and Applications with Embedded Systems*. Springer Berlin Heidelberg.
2. Craig John, J. 2005. *Introduction to Robotics*. Pearson Education Inc., Asia, 3rd Edition.
3. Ghoshal, Asitava. 2006. *Robotics: Fundamental Concepts and Analysis*. Oxford University Press.
4. Gonzalez and Wintz. *Digital Image Processing*. 3rd edn.
5. Jha, S. N. 2015. *Rapid Detection of Food Adulterants and Contaminants: Theory and Practice*. Elsevier, USA (ISBN 9780124200845), p266.
6. Jha, S. N. (ed.). 2010. *Nondestructive Evaluation of Food Quality: Theory and Practice*. Springer – Verlag GmbH Berlin Heidelberg, Germany, ISBN 978-3-642-15795-0, doi 10.1007/978-3-642-15796-7: 288p.
7. Nikku, S. B. 2020. *Introduction to Robotics – Analysis, Control, Applications*. 3rd edition. John Wiley & Sons Ltd., 2020.
8. Nilsson Nils, J. 1980. *Principles of Artificial Intelligence*. Elsevier.
9. Rich, Knight and Nair. *Artificial Intelligence*. Tata McGraw Hill.
10. Saha, S. K. 2014. *Introduction to Robotics*. Tata McGraw Hills Education, 2014.
11. Schilling Robert, J. 1990. *Fundamentals of robotics – Analysis and control*. Prentice Hall of India.

Agricultural Structures and Environment Control

3 (2+1)

Objective

1. To make the students acquainted with the different types of agricultural structures
2. To enable them to prepare plan and estimate for different farm structures and environment control measures.

Theory

Farm and farmstead, farmstead planning and lay out; Environmental control- scope, importance and need, physiological reaction of livestock, environmental control, systems and design, control of temperature, humidity and air ventilation; BIS standards for dairy, piggyery and other farm structures.

Farm structures- design, construction and cost estimation of farm structures, animal shelters, compost pit, fodder silo, farm fencing, implement shed, barn for cows, buffalo, poultry etc.; Greenhouses- types, poly houses /shed nets, cladding materials, plant environment interactions, design and construction of greenhouses, site selection, orientation, design for ventilation requirement using exhaust fan system, selection of equipment, greenhouse cooling and heating system.

Grain storage structures- grain storage methods, moisture and temperature change in grain bins, traditional storage structures and their improvement, improved storage structures (CAP, hermitage storage, Pusa bin, RCC ring bin), design consideration for grain storage go-down, bag storage structure, shallow and deep bins, calculation of pressure in bins; Storage of seeds.

Rural housing and development; Farm roads- types of roads in the farm, construction methods, repair and maintenance of rural roads; Water supply and sanitation- sources of water supply for human beings and animals, drinking water standards, water treatment for rural community, site selection and orientation of buildings for sanitation; Sewage system and design, maintenance, septic tank for small family.

Rural electrification- estimate of domestic power requirement, sources of power supply, electrification for rural housing.

Practical

Measurement of environmental parameters, Temp, RH, wind velocity, cooling load; Design and layout of a dairy farm; Design and layout of a poultry house; Design and layout of a goat/sheep house; Design and layout of a farm fencing system; Design and layout of a feed/fodder system; Design and layout of a green house; Design and layout of a grain storage structure; Design and layout of a bag storage structure; Performance of domestic storage structure; Design layout of a threshing floor.

Suggested Readings

1. Banerjee, G. C. 2007. *A Text Book of Animal Husbandry*. Oxford IBH Publishing Co, New Delhi.
2. Dutta, B. N. 2016. *Estimating and Costing in Civil Engineering*. Dutta & Co, Lucknow.
3. Garg, S. K. 2010. *Water Supply Engineering*. Khanna Publishers, New Delhi.
4. Khanna, P. N. 1958. *Indian Practical Civil Engineer's Hand Book*. Engineer's Publishers, New Delhi.
5. Nathanson, J. A. 1996. *Basic Environmental Technology*. Prentice Hall of India, New Delhi.
6. Ojha, T. P. and Michael, A. M. 1966. *Principles of Agricultural Engineering*. Vol. I. Jain Brothers, Karol Bag, New Delhi.
7. Pandey, P. H. 2004. *Principles and Practices of Agricultural Structures and Environmental Control*. Kalyani Publishers, Ludhiana.
8. Rao, P. V. 2012. *Text Book of Environmental Engineering*. Prentice Hall of India, New Delhi.
9. Sahay, K. M. and Singh, K. K. 2004. *Unit Operations of Agricultural Processing*. Vikas Publishing Pvt. Ltd, Noida.

Bioenergy Systems: Design and Applications

3 (2+1)

Objective

To make the students acquainted with the different biomass sources, and the different thermochemical and biochemical processes for bioenergy and fuel production