

8. Rai G D. 1995. *Solar Energy Utilization*. Khanna Publishers, New Delhi.
9. Rai G D. 2013. *Non-Conventional Energy Sources*. Khanna Publishers, New Delhi.
10. Sahay K M and Singh K K. 1994. *Unit Operations of Agricultural Processing*. Vikas Publishing house Pvt. Ltd, New Delhi.
11. Suresh R and Kumar Sanjay. 2018. *Farm Power and Machinery Engineering*. Standard Publisher Distributors, New Delhi.
12. Suresh R. 2014. *Soil and Water Conservation Engineering*. Standard Publisher Distributors, New Delhi.

## Surveying and Levelling

3 (1+2)

### Objective

To enable the students to conduct the survey work for any area and also to prepare layout of engineering structures

### Theory

Surveying: introduction, classification and basic principles; Linear measurements, chain surveying, cross staff survey, compass survey, planimeter; Errors in measurements, their elimination and correction; Plane table surveying, methods, advantages and disadvantages.

Levelling, levelling difficulties and error in levelling, contouring, computation of area and volume.

Theodolite traversing, introduction to setting of curves; Total station, electronic theodolite; Introduction to GPS survey.

### Practical

Linear measurements using different instruments; Reconnaissance survey in the field; Use of field book; Study on various types of chain used in chain survey and its components; Study of errors in chain surveying; Use of ranging rods and ranging in the field; Obstacles during chaining; Offsets in chain survey; Cross Staff; Survey of an area; Preparation of map; Study on various types of compass; Compass survey of an area; Plotting of compass survey; Plane table surveying and different methods; Study on various types of levels and its components; Setting up of dumpy level in the field; Computation of various methods for RL; Study on Levelling, L section and X sections and its plotting; Measurement of slope in the field; Study on contour and its characteristics; Contour survey of an area and preparation of contour map; Introduction of software in drawing contour; Theodolite surveying; Ranging by Theodolite; Height of object by using Theodolite; Setting out curves by Theodolite; Use of minor instruments; Use of total station, EDM in the field; Use of modern computers for surveying

### Suggested Readings

1. Agor R. *A Text Book of Surveying & Levelling*. Khanna Publishers, New Delhi
2. Arora K R. 1990. *Surveying (Vol. I)*, Standard Book House, Delhi.
3. Kanetkar T P. 1993. *Surveying and Levelling*. Pune Vidyarthi Griha, Prakashan, Pune.
4. Punmia B C. 1987. *Surveying (Vol. I)*. Laxmi Publications, New Delhi.

**Workshop Technology and Practice****2 (0+2)****Objective**

To expose the students to basic manufacturing processes involved for production of different machine elements and to facilitate hands-on experience of using these machines.

**Practical**

Introduction about different shops in the workshop; Safety and precautions to be taken in the workshop; Study of different tools used for fitting and different fitting operations; Study of various measuring instruments used for fitting; Exercise in fitting: sawing, filing and right angle fitting of MS flat; Working with complex fitting jobs: operations of drilling, reaming, and threading and with tap dies; Preparation of a paper weight; Study of various carpentry tools, types of wood and their characteristics and working with carpentry tools; Preparation of simple joints in carpentry: cross half lap joint or T-half joint, Mortise and Tenon joint in carpentry; Preparation of dovetail joint in carpentry; Study of welding, types of welding, oxyacetylene gas welding, types of flames, welding techniques and equipment used for gas welding, working with welding equipment; Working with electric arc welding; Equipment and tools, safety and precautions taken in arc welding; Preparation of Butt joint and lap joint with ARC welding; Preparation of Lap and butt joints using gas welding; Working on a lathe machine and study of different tools used in lathe machine; Exercise on simple turning, step turning in lathe machine; Preparation of job on taper turning, drilling, knurling and threading in lathe machine; Working with different machines in machine shop such as shaper, milling machine, etc. and with different tools used in machine shop; Exercise on bending, shaping etc.; Exercise on Drawing, Punching, Riveting; Making different types of sheet metal joints using G.I. sheets; Practice job on shaper; changing a round MS rod into square section with a shaper; Exercise on a milling machine such as making a slot, gear tooth forming and indexing

**Suggested Readings**

1. Chapman W A J. 2018. *Workshop Technology* (Vol. I and II). Arnold Publishers (India) Pvt. Ltd., AB/9, Safdarjung Enclave, New Delhi.
2. Hajra Choudhury S K, Roy N, Hajra Choudhury A K. 2017. *Elements of Workshop Technology* (Vol. I and II). Media Promoters and Publishers Pvt. Ltd, Mumbai.
3. Khurmi R S and Gupta J K. 2018. *A Text Book of Workshop Technology*. S. Chand & Company Ltd, New Delhi.
4. Raghuwansi B S. 2016. *A Course in Workshop Technology* (Vol. I and II). Dhanpat Rai and Sons, 1682, Nai Sarak, New Delhi.

**Basic Electrical Gadgets and Instruments****3 (2+1)****Objective**

To enable the students to take up repair and maintenance of different common electrical gadgets and instruments.

**Theory**

Introduction to different electrical appliances used in agricultural buildings, structures and farm .0operations; Difference between AC and DC supply system; Introduction to AC fundamentals; AC