454/455

OPEN VOCATIONAL EDUCATION PROGRAMME

Diploma Course in

BASIC RURAL TECHNOLOGY

454 - Rural Engineering

(Material,Mechanics,Drawing & Costing)

455 - Home Environment & Basics of Electricity

NATIONAL INSTITUTE OF OPEN SCHOOLING

Open Vocational Education Programme

Course Code-454

Basic Rural Technology

3

RURAL ENGINEERING

(MATERIAL, MECHANICS, DRAWING & COSTING)

Course Coordinator

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Basic Rural Technology

RURAL ENGINEERING

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FROM THE DESK OF CHAIRMAN ....

Dear Learner,

Welcome to the National Institute of Open Schooling!

By enroling with this institution, you have become a part of the family of the world's largest Open Schooling System. As a learner of the National Institute of Open Schooling's (NIOS) Vocational Programme, I am confident that you will enjoy studying and will benefit from this very unique School and method of training.

Before you begin reading your lessons and start your training, there are few words of advice that I would like to share with you. We, at the NIOS, are well aware that you are different from other learners. We realize that there are many of you who may have rich life experiences; you may have prior knowledge about trades and crafts that are part of your family's legacy; you may have a sharp business sense that will make you fine entrepreneur one day. Most importantly, you have the drive and motivation that has made you enrol with this institution, which believes in the spirit of freedom. Yes, we are aware that you have many positive aspects to your personality, which we respect and relate to them.

During the course of your study, NIOS will treat you as the manager of your own learning. This is why your course material has been developed keeping in mind the fact that there is no teacher to teach you. You are your own teacher. Of course, if you have a problem, we have provided for a teacher at your Accredited Vocational Institution (AVI). I would advise you that you should always be in touch with your AVI for collection of study material, examination schedules etc. You should also always attend the Personal Contact Programmes and practical / Training sessions held at your study centres. These will give you the necessary hands on training that is very essential to master a vocational course.

Studying for a vocational course is different from any other academic course. Here, while the marks obtained in the examination will indicate your grasp on your subject knowledge, your real achievement will be, when you are able to apply your vocational skills in the market. I hope that this skill-based learning will help you perform your tasks better . This course of two year duration, Diploma in basic Rural Technology, has been developed in collobotation with Vigyan Ashram, Pune. It is a multi skilled programme, which will expose you to a variety of skills. We hope that you will find it useful. On behalf of NIOS, I wish you the very best for a bright and successful future.

Dr. S. S. Jena, Chairman,

National Institute of Open Schooling

FROM THE DESK OF DIRECTOR .....

Dear Learner,

In the fast expanding world of activities, learning new skills has become a necessity. Learning and re-learning has become essential for all. In such an environment, vocational education has assumed great importance. Vocational education, as a stream of education, promotes skill development, and training of youth and directs them towards meaningful employment.

In keeping with the needs of the Learners, NIOS conducts Vocational Education Programmes in many areas through distance mode. These programmes include Agriculture, Home Science, Engineering & Technology, Computer Science, Health & Paramedical. The Courses offered in these areas are aimed at providing self employment & wage employment opportunities for NIOS learners.

Vigyan Ashram under the leadership of late Dr.S.S.Kalbag, developed Rural Technology course for rural youth. Over the years, this course turned many youth into successful entrepreneurs. NIOS accrediated this course as Diploma in Basic Rural Technology and adopted it for further replication through AVI. This course will provide self-confidence to you and a new path to your future. You may be destined for starting a small enterprise and build your own future. This is multi-skilled programme, which will expose you to variety of skills. It includes Rural Engineering (Construction), Agriculture & Animal husbandry, Our Home Environment and Health sections. This will help in identifying learner's preference for future vocation. We are confident that this course will prove to be beneficial to you.

We wish you all the best in your future career.

Dr. K. P. Wasnik ,Director (VE),

National Institute of Open Schooling

A WORD WITH YOU...

Dear Learner,

Welcome to the Open Vocational Education Programme: "Basic Rural Technology"

This programme is developed specially for all those who are school dropouts and have started many small enterprises, do agriculture work as skilled workforce and they contribute substantially to the progress of India.

The multi-skill content with hands-on experience of this programme stimulates the intellect by going through concrete operations and then abstracting the concepts. At the same time by giving a variety of skills usable in everyday life, open the door of modern technology to the youth, allowing them to form their preferences and know their aptitudes thus enabling them to choose a career. It also improves their self-image and gives them confidence and hope for the future. The level of training, though basic, empowers them to start their own enterprise after a short stint with another enterprise in the field. Basic Rural Technology content and the system of Hands-on training not only make the education relevant but also understandable because it uses the 'learning while doing' system and is closely linked to services to the community. Students will get training by working in real life environment. Learner will also learn basic skill like Drawing, costing and project planning in DBRT programme.

The Self – Instructional Material of this programme consists of Four Modules: 1. Our Health, 2. Agriculture & Animal Husbandry, 3. Rural Engineering (Material, Mechanics, Drawing & Costing) and 4. Our Home Environment. Learner friendly approach has been adopted throughout this material. Each lesson is written in very simple and chronological order. The in- text questions are included in the text matter to analyze the learner's understanding of the lesson. The suggested activities are provided that go beyond classroom.

We hope that this programme will help you to carve an niche in your career and play an important role in the society.

With best compliments

Dr. Pawan Kr. Chauhan
Executive Officer (HPM)
National Institute of Open Schooling

DIPLOMA COURSE IN BASIC RURAL TECHNOLOGY

Introduction

About 90% of the children, who enroll in the primary school, do not cross the Senior Secondary (SSC) barrier. It is not that these children are unfit for education, in fact, they are the major work force for India. They start many small enterprises, do agriculture, works as skilled workforce and contribute substantially to the progress of India. They have probably dropped out because our book based education system did not suit them and the children lost interest in all education. Very often the very thought of schooling and examination frightens them.

The country is faced with a large proportion of school dropouts and a corresponding problem of unemployment and under-performance in the unorganized sector. In the present changing world scenario, this is a great handicap to progress of country. We, therefore, need a system by which the problem will be treated at the grass root level.

The main cause of this dropout problem is that our education system is almost entirely book based and a large section of the students, both during and after the schooling, find the education incomprehensible and irrelevant.

The multi-skill content of the Basic Rural Technology Course with hands-on experience stimulates the intellect by going through concrete operations and then abstracting the concepts. It uses the 'learning while doing' system and is closely linked to services in the community. At the same time by giving a variety of skills usable in every day life, they open the door of modern technology to the youth, allowing them to form their preferences and know their aptitudes, thus enabling them to choose a career. It also improves their self-image and gives them confidence and hope for the future. The level of training, though basic, empowers them to start their own enterprise after a short (less than a year) stint with another enterprise in the field.

The Diploma in Basic Rural Technology is the right course for such students. This course will give learners self-confidence and give a new path to their future. Learners may be destined for starting a small enterprise and build their own future.

This multi-skill program, will expose the learners to a variety of skills. Learners will work in Engineering-Construction, Energy-Environment, Agricultural and Animal husbandry and Health sectors. This will help in identifying Learners preferences for future vocation. This program is based on philosophy of "Learning while doing'. Students will get training by working in real life environment. They will also learn basic skills like drawing, costing and project planning in DBRT program during their training.

Objectives of the Course & Scope

Diploma in Basic Rural Technology, comprising of theory & practical component, is intended to *give learners self-confidence and a new path to their future. Learners may be destined for starting a small enterprise and build their own future. This is multi-skill programme, which will expose them to variety of skills. Learners will works in Engineering-Construction, Energy-Environment, Agricultural and Animal husbandry, home and health sections. This will help in identifying Learner's preference for future vocation.*

The programme is based on philosophy of "Learning while doing'. Students will get training by working in real life environment. Learner will also learn basic skills like Drawing, Costing and Project Planning in DBRT programme. The main objectives of this course are:

- To train the students using 'Learning while Doing' Philosophy.
- To train them for income generation through self-employment.
- To train students in multi-skills.
- To train students in different technologies and transfer these technologies to the society through them.
- To involve students in various rural development activities as a project work, thus integrating rural development and Education.
- To make available various services to the community at the modest cost and giving real life training to the students.

Eligibility Criteria

The admission for Diploma in Basic Rural Technology is open to those who fulfill the following Criteria:-

- Class 8th passed (Any one, who is willing to work with hands, handle machinery or play with animals or likes to grow plants, is well suited for this course. Learner should have passed the 8th standard school examination, so that learner can read and write fluently, do simple calculations.)

Job Opportunities

After passing through this course, the students can do apprenticeship in one of the areas of his interest and develop his career. Multiskilling helps in getting job in the following fields:-

1. Workshop in small scale industries / construction sites / Fabrication units.
2. Supervisor in agriculture and polyhouses / animal husbandry units such as poultry , dairy, goat farming etc.
3. In food processing industries.
4. Electric and Electronics workshops.

He can start his own enterprise after sufficient apprenticeship.

Duration of the Course

The duration of the course is two years. However, one can complete the course within five years of registration by appearing in any external examination as per rules of NIOS in force from time to time. The AVIs will be responsible for imparting training, skills and competencies of a qualitative standard by adopting suitable training methods, strategies & systems.

Attachment of Trainees : Minimum 06 months attachment of trainee for internship.

Scheme of Study : 30% in Theory & 70% in Practical Course Curriculum

The course curriculum comprises of four modules having both theory & practical components.

Out of four modules two are related to the living world and two to the non-living. Home- Environment (related to human society), and Agriculture (Plant and animal Kingdom) give the skills related to clothing, food and health of the society. Agriculture covers the skills needed for production and preservation of food of both plant and animal origin, including care of plants/crops, birds and cattle and their breeding. The Engineering

Programme	Duration	Essential Contact Hrs. for Theory & Practical Training
Diploma in Basic Rural Technology	Two Years	600

Course Curriculum

The course curriculum comprises of four modules having both theory & practical components.

Subjects/Papers for First Year	Subjects/Papers for final Year
• Module - 1: Our Health	• Module – 3: Rural Engineering *((Material, Mechanics, Drawing & Costing)*
• Module – 2: Agriculture & Animal Husbandry	• Module – 4: Our Home Environment (Home Environment Basics of Electricity)

Out of four modules two are related to the living world and two to the non-living. Home- Environment (related to human society), and Agriculture (Plant and animal Kingdom) give the skills related to clothing, food and health of the society. Agriculture covers the skills needed for production and preservation of food of both plant and animal origin, including care of plants/crops, birds and cattle and their breeding. The Engineering (material-joining, shaping and otherwise fabricating into usable things, including housing) and Energy-Environment (application of electricity and maintenance of Diesel, petrol and other IC Engines, non-conventional principles). The content though it looks formidable, is easily worked through because of the 'learning while doing' method. Of course the mastery depends on the student putting hard work for practice, for which ample opportunities are given. The students are encouraged to take on contract jobs involving these skills for practice and reinforcement.

The study material will be provided in the form of self-instructional print material and the practical component/training shall be provided to each student at the study centres(AVI's).

Medium of Instruction

The medium of instruction is English.

Instructional System

- Self instructional printed material
- Visual support system

- Assignments
- Face to face counseling at AVIs/Study centres
- Practical/Training facilities at AVIs/Study centers
- On the job training, wherever applicable/required.

Scheme for Evaluation/Certification

There will be evaluation of both components, the theory as well as the practical separately. Internal assessment will also be taken into account while computing final result. The scheme of Assessment, Evaluation and Certification will be administrated through the guidelines designed by NIOS. NIOS will award the final certificate according to its rules and regulations.

Basic Rural Technology Training Prog.	**Theory**		**Practical**			
Paper	Max. Marks	Duration	Max. Marks In Practicals	Duration	Max. Marks in Project Work	Total
Paper – I Our Health	30	1 hr	50	2 hrs	20	100
Paper – II Agriculture & Animal Husbandry	30	1 hr	50	2 hrs	20	100
Paper – III Rural Engineering (*(Material, Mechanics, Drawing & Costing)*	30	1 hr	50	2 hrs	20	100
Paper – IV Our Home Environment	30	1 hr	50	2 hrs	20	100
					Grand Total	400

MINIMUM PASSING CRITERIA

- In Theory, a trainee should secure 40% marks in each module/paper.
- In Practicals, a trainee, should secure 50% marks in each paper.
- In Internal Assignment, a trainee should secure 50% marks in each paper.

Procedure for Internal continuous Assessment

Practical / Training (Internal Assignments):

Assessment will be done by maintaining progress card of each candidate, indicating assessment of each Practical / experiments. (Total Marks = 80)

Course Fees:

A student will pay Rs.4000/- (Rs.500/- + Rs. 3,500/-) for the full course and will receive a set of printed material. In addition, the examination fee will be paid separately as per the NIOS rules.

Admission Procedure

Admission is done twice a year as per the dates notified by the NIOS. Application forms and Prospectus can be procured from either the NIOS or its Study Centrs (AVIs).

Criteria/Norms for Accreditation

The institutions having the following basic infrastructure may apply for accreditation:

(A) **Basic Infrastructure:**

1. Class Room: Classroom to accommodate 25 students (minimum area 225Sq. ft.) should have black board/white board, proper ventilation, adequate lighting, furniture, exhaust and ceiling fans etc.
2. One Lab: The Lab to accommodate 25 students (minimum area at least 20 ft. × 25 ft.) should have black board/white board, proper ventilation, adequate lighting, furniture, exhaust and ceiling fans etc.
3. One Workshop: The workshop to accommodate 25 students (minimum area at least 20 ft. × 25 ft.) should have black board/white board, proper ventilation, adequate lighting, furniture, exhaust and ceiling fans etc.
4. Agriculture land: Agriculture land for growing and cultivation the plants/crops.
5. Tools/ Environment: Details in this regard is available on our website.

Library: Library should have minimum 20 books/articles/magazines etc. related subject.

(B) Faculty & Supporting Staff

Batch Size – Maximum 25 students in one batch.

S.No.	Faculty & Supporting Staff	Educational/Professional Qualification	No.
1.	Coordinator	Graduate	01
2.	Instructor (part time)	Degree/Diploma in Nursing	01
3.	Instructor – Agriculture & Animal Husbandry	Degree/Diploma in Agriculture/Animal husbandry-DBRT with sufficient practical experience.	01
4.	Instructor – Engineering	Degree/Diploma in Engineering discipline – ITI-DBRT with sufficient practical experience.	01

5.	Instructor – Food lab.	Class 12th Pass – Home science or DBRT with practical experience in food processing	01
6.	Receptionist cum clerk	Relevant to job	01

Batch Size – Maximum 25 students in one batch.

FUNDAMENTAL DUTIES

Part IV A (Article 51 A)

It shall be the duty of every citizen of India -

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.

A brief Guide to NOS web site

The success of open learning and distance education very much depends upon the harnessing of the new and latest technology. The emerging Internet and Web technology help in effective dissemination of knowledge breaking all geographical boundaries. The web-site is a dynamic source of latest information and is also electronic information guide. The contents in the **NOS** web site are open to all.

The learners can have an access to NOS web-site at the following address:

http:/www.nos.org

Clicking this site address will bring the user to NOS Home Page that will further guide them to visit different information pages of **NOS**. NOS is also developing a school network through Internet known as **Indian Open Schooling Network (IOSN)**. The network will provide a common communication platform for learners and educators. NOS is offering **Certificate in Computer Applications (CCA)** through selected AVI. This course is also offered through Internet on NOS Web-Site.

Basic Rural Technology

3

RURAL ENGINEERING

(MATERIAL, MECHANICS, DRAWING & COSTING)

Course Content

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2	Basic Engineering Concepts	9
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6	Construction	51
7	Mass and Energy	65
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10	Engineering Drawing	85
11	Orthographic and Isometric Projection	95
12	Flow Charts & Graphs	110

Notes

1

MEASUREMENT

1.1 INTRODUCTION

We measure various things in our daily life. In the past, measurements were done using different parts of human body. For e.g. Feet, handbreadths, fathom etc. But there are many limitations on accuracy of such measurements. For e.g. length of handbreadth varies from a person. Therefore, need of standard measurement practices was emerged. The method of measurement depends upon the accuracy required. In this chapter, we are going to study measurement, commonly used units, basic units and derived units.

1.2 OBJECTIVES

After reading this lesson, you will be able to:

- Know Importance of measurement, SI units.
- Understand Quantitative and Qualitative measurements.
- Know Base Units and derived units.
- Understand Least Count of instruments.
- Estimate weight of goods.

1.3 IMPORTANCE OF MEASUREMENT

In today's world, we cannot do without measurement. Grocery shop owner needs to measure weight, doctors measures temperature, blood pressure, Two wheeler mechanics measures tyre pressure, milkman measures milk, mesons measures wall length etc. Measuring units become essential part of proper communication.

Module - 3

Notes

1.4 QUANTITATIVE AND QUALITATIVE MEASUREMENTS

We get new information everyday and from this information, we derived knowledge. "This year we got good yield of rice". This is a descriptive (qualitative) information. "This year we produce ten quintal rice"; this is quantitative information. Quantitative information is more useful than the descriptive information. Science depends upon such quantitative information. Therefore, it is necessary to measure all the characteristics. Few examples of qualitative and quantitative informations are given below:

Qualitative Information	Quantitative information
Give me little water.	Give me 200ml of water.
Give me some money	Give me twenty rupees.
I ate sufficient food.	I ate two chapattis.

Table: 1

Please refer table.1 for more examples. This 'little', 'sufficient', 'good', 'enough', 'lot' are the example of qualitative information. Whereas, quantitative information like 200ml, Rs.20, 2 chapattis, 5 quintals, 500mm, 5 bags gives specific information. Recording everything is basic requirement for improving productivity. Collecting proof, based on quantitative information is must to support your invention.

INTEXT QUESTIONS 1.1

Identify Quantitative and Qualitative information:

1) We got good yield of crop. _____.
2) We got 5 quintals of rice. _____.
3) This year there is enough rain. _____.
4) This year we got 500mm rain. _____.
5) This construction needs lot of cement. _____.
6) This construction needs 5 bags of cement. _____.

1.5 MEASUREMENT AND SI UNITS

Measurement is nothing but a measuring attribute of an object with other known attribute of similar object. The known things are called standards. In the past, there were different standard of measurement in different countries. Prominent among them are British standards and French Metric system. Now there are international standards (SI) for measurement.

In our country only use of SI standard is legal. Therefore, you will find only SI units in all Government contracts and agreements. We will discuss only SI units in our study. Different measuring parameters and their measuring units are shown in the table below:

Parameter	British Unit	SI Units
Weight	Pound	Kg.
Volume	Gallon	Liters
Distance	Yard, miles, inches	Meters
Time	Second	Second

Table: 2

The characteristic that we measure is called as Parameter. Some of the important Parameters and their Units are given in table 2.

1.6 INTERNATIONAL STANDARDS OF UNITS

The International System of Units (SI) is the modern, revised form of the metric system developed by French people. The SI unit allows easy multiplication when switching among units having the same base but different prefixes. To convert from meters to centimeters it is only necessary to multiply the number of meters by 100. Inversely, to switch from centimeters to meters, one multiplies the number of centimeters by 0.01.

Observe scale given in fig.1.1. It gives conversion of various units into meter. For e.g. 1 cm = 0.01m, 1 kilometer = 1000 meter.

Base unit:

There are two types of SI units, base and derived units. Base units are the simple measurements for time, length, mass, temperature, electric current and light intensity.

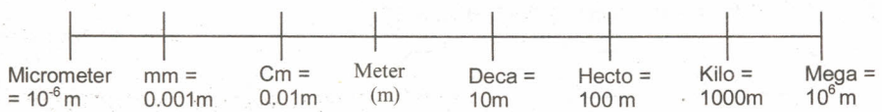


Fig. 1.1 - Meter and its multiple units

Commonly used base units are:

Derived units:

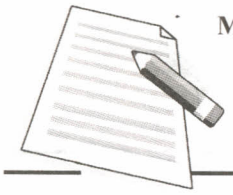
Derived units are made up of base units, for example, unit of speed is m/s, which is combination of unit of distance and time. Commonly used base units and their symbol names are given below:

	Name	Symbol
Length	Meter	M
Mass	Gram	Gm
Time	Second	S
Electric Current	Ampere	A
Temperature	Degree Centigrade	°C

Table: 3

Derived units are calculated as follows:

1) Speed = Distance / time, unit of distance is meter and time is second.



Example of Derived units and their symbol names are given in Table below:

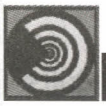
Therefore, unit of speed becomes m/s

2) Area of square = length * breadth, unit of length and breadth is meter.

Therefore, unit of area = m * m = m^2

Derived Quantity	Name	Symbol
Area	Square meter	m^2
Volume	Cubic meter	m^3
Speed, Velocity	Meter per second	m/s
Acceleration	Meter per second	m/s^2
Density	Mass per volume	Kg/m^3

Table: 4



INTEXT QUESTIONS 1.2

1) Convert the following:

50 cm = _____ m

5.5 km = _____ m

1600 m = _____ km

102 mm = _____ m

2) Observe different weight and answer:

500g + 500g = _____ kg

1.7 MEASURING OTHER PARAMETERS

How to measure other characteristic which are not following in base or derived units for e.g. testing good behavior, smell, magnetism, light, colour etc.

Measurement is nothing but comparison. For measuring something,we select unit and consider it as standard. Therefore we judge the characteristics by measuring how many times the characteristics is more than the selected standard unit. For e.g. by considering sweetness of sugar as a unit, we can decide how many times is the sweetness of sweet.

Factors affecting measurement:

No measurement is absolute in nature. It is very difficult to claim that any measurement is 100% accurate. But we can always reduce the errors in measurement.

Accuracy depends on lots of factors:

i) Reading taken by the individuals.

ii) The way of measurement.

iii) Alertness of individual and care taken by him in measurement.

iv) Error due to variation in the measuring instruments.

In mathematics we get exact answer for $2 \times 2 = 4$, but while measuring 4 meter it may be measured as 3.995 meter or 4.007 meter. This is not a wrong measurement but it is lack of accuracy. Practically, there are limitations to achieve 100% accuracy and it is not possible to have 100 % accuracy every time.

Least count of an Instrument

The smallest measurement, you can make using an instrument is the least count of that instrument. For example on a small scale in your compass box, smallest measurement you can make is 1mm. This means least count of scale is 1mm.

Do not use any instrument to measure below least count of that instrument. This means, if you want to measure 0.05 mm then regular scale is not a good device.

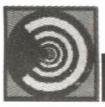
While measuring always take measurement one decimal higher than the least count on the measure. For example if on the Scale, millimeter is the smallest sign of measure, then do not measure less then 0.1 millimeter. Further, in decimal if last number is 5 or more than 5, then make number previous to it as 1. For example in measurement of 3.9935 make it 3.994.

Selection of instrument depends on the accuracy required. For example

i) We can use wrist watch to measure time but for athletics competition in Olympic, we need digital watch.

ii) To measure length of a wall, we can use a tape but for measuring length of compass -box we need to use scale.

iii) To measure weight of a truck, a weigh bridge is used. But grocery shop owner use simple balance.



INTEXT QUESTIONS 1.3

i) Name proper instruments to measure following jobs:

Job	Instrument
Diameter of rod	
Current	
Temperature	
Measure weight	

ii) Write down least count of following instruments:

Vernier caliper = _____

Meter tape = _____

Wrist watch = _____

1.8 ESTIMATING WEIGHT OF GOOD

Due to convention, many times we use different units than SI units. Many times things are sold using different measurement. For example Iron is sold on per Kg weight. This means though we measure dimension for manufacturing 'Table' in length, still we need to measure its weight. For making estimate of a job, we have to calculate the weight of the angle used. The formula for calculation is given below:

Weight of material = Density of material × volume of job.

Volume of a job = Area of cross section of an object × length of object

Density of iron is 7.87 gm/cm^3 or 7870 Kg/m^3

Example:

1) Calculate a weight of 4 cm diameter iron rod of 100 cm. in length.

Diameter = 10 cm Area = π / 4 × D^2

Area = 3.14 / 4 × (4 × 4) = 12.56 cm^2

Volume = Area × Length = 12.56 × 100 = 1256 cm^3

Weight = Density × Volume = 7.87 × 1256 = 9884.72 gm = 9.88 Kg

2) Calculate weight of a 25 × 25 × 3 mm angle of length 3 meter

Length = 25 mm = 2.5cm, thickness = 3 mm = 0.3 cm, Length = 3 mtr = 300cm.

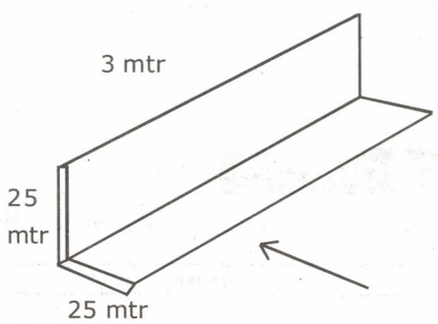


Fig: 1.1

Area of cross section = (Area of vertical cross section) + Area of horizontal cross section

= (Length × breadth) + (Length × breadth)

= (2.5 × 0.3) + (2.5 × 0.3) = 1.5 cm^2

Length = 3 mtr. = 300 cm

Volume= Area × Length = 1.5 × 300 = 450 cm^3

Weight = Density × Volume

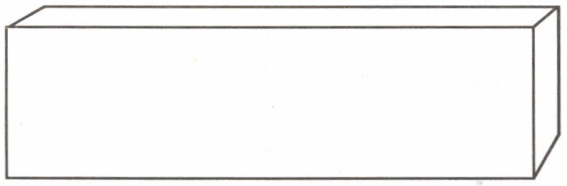
= 7.87 × 450 = 3541.5 gm = 3.54 Kg

1.9 WHAT YOU HAVE LEARNT

In this chapter, we have learned about measurement, types of measurement, base unit and derived units. We have studies quantitative and qualitative measurement. We also discussed SI units and International standards of units. We also discussed about factors affecting selection of instruments, least count of instrument. At the end, we learned to calculate weight of goods.

1.10 TERMINAL QUESTIONS

1) Write down factors affecting selection of measuring instruments.
2) Estimate weight of iron flat of following dimension.



L = 3 meter, Breadth = 0.5 meter, thickness = 5 cm

Density of iron is 7.87 gm/cm^3 or 7870 Kg/m^3

1.11 ANSWER TO INTEXT QUESTIONS

1.1

1)	We got good yield of crop.	Qualitative
2)	We got 5 quintals of rice.	Quantitative
3)	This year there is enough rain.	Qualitative
4)	This year we got 500mm rain.	Quantitative
5)	This construction needs lot of cement.	Qualitative
6)	This construction needs 5 bags of cement.	Quantitative

1.2 i) 0.5m, 5500m, 1.6km, 1.02m

Notes

ii) 1 Kg

1.3 i) vernier caliper, Ampere meter, Thermometer, Balance

ii) 0.01cm, 1mm, 1 second

SUGGESTED ACTIVITIES

1) Measure dimensions of your house.
2) Read and write down different parameters and units written on biscuit or any other packet.

2

BASIC ENGINEERING CONCEPTS

2.1 INTRODUCTION

In scientific language each word has clear and specific meaning. Therefore, commonly used words are avoided in scientific language. For example, Mass and weight are two different term. Your mass on earth and on moon is same. But you weight will be less on moon than earth. That is the reason, astronauts' floats in the space. In this chapter, we will discuss commonly used scientific terminology.

2.2 OBJECTIVES

After reading this lesson, you will be able to:

- Understand basic engineering concepts.
- Understand relationship between work, force and Power.
- Learn the Law of conservation.
- Know scalar and Vector.

2.3 MASS AND WEIGHT

- Generally, **mass** is defined as the measure of how much matter an object or body contains. It is measured in Gram (g).
- **Weight** is the amount of force that earth exerts on us. More the mass of object more is the gravitational force on the object. If we drop an object from a height, earth pulls it at the acceleration of $9.8 m/s^2$
- **Acceleration** is the rate of change of speed. This means speed of an object will increase by 9.8m every second. This means, if an object falls from a height to reach earth, after 10 second it would have achieve speed of $9.8 \times 10 = 98$ m/s.

- Force causes acceleration, Sir Isaac Newton's Second Law states that the acceleration (a) of an object is directly proportional to the force (F) applied, and inversely proportional to the object's mass (m).

Newton's Second Law is usually summarized in equation form:

$a = F/m$, or $F = ma$

Unit of force is derived as follows -

Unit of force F = m (Kg) × a (m/s^2) = Kg m/s^2 = N

To honor Newton's achievement, the standard unit of force i.e kg m/s^2 in the SI system is named as Newton (N). One Newton (N) of force is enough to accelerate 1 kilogram (kg) of mass at a rate of 1 meter per second square (m/s^2).

A kilogram is the amount of weight at which 1 N of force will accelerate at a rate of 1 m/s^2.

In practice, we measure weight, in terms of gms. or Kgs. But when weight is used as force, we must remember to measure it in terms of Newton.

INTEXT QUESTIONS 2.1

Fill in the blanks:

i) _____ is the rate of change of speed.

ii) Weight is measured in grams, but when weight is used as force, we measure it in terms of _____.

2.4 FORCE

As studied earlier, weight is the kind of force that the earth exerts on us. As shown in the Fig.2.1 there are multiple forces applied on a car from different direction. Gravitational force puts downward force on the car, engine puts forward force etc. some forces gets balanced by equal and opposite force e.g. downward gravitational force gets balanced by equal and apposite force exerted from ground.

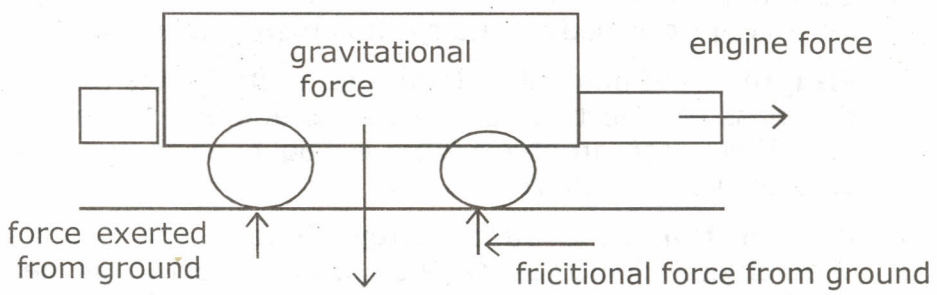


Fig.2.1 Multiple forces applied on car

Car moves forward when forward engine force overcomes frictional force from the road.

2.5 TORQUE

Torque is a force that tends to rotate or turn things. Refer Fig.2.2, you generate a torque whenever, you apply a force to turn handle of diesel engine.

Torque = Force × Distance from the center.

Unit of Torque = N × m = Nm.

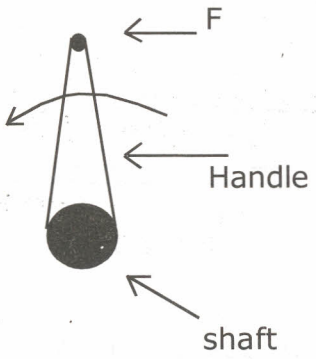


Fig: 2.2 : Torque

It is common experience, that a nut which is hard to move by hand can be easily rotated when a spanner of longer length is used. Increasing length of application of force from the center of shaft increases torque applied.

2.6 WORK

Work is the application of a force over a distance. When we lift an object from the ground and put it on the shelf, we do work. The

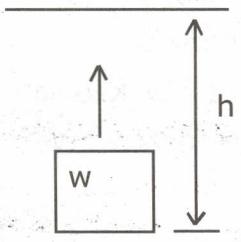


Fig 2.3 (a)

force is the weight of the object and distance is the height of the shelf. Similarly, when we push an object and moves it, we do work.

The distance taken for calculating work has to be in the direction of force applied.

Example: Ref fig.2.3(a), a weight of 50kg. is lifted to height of 5 meter. Calculate the work done.

Work = force × distance through force is applied

= (W kg × 9.8) × h (W = 50kg, h = 3m)

= 50 × 9.8 × 3 = 1470 Nm

When we push an object and it moves through a distance L ref. Fig.2.3(b) the work done is calculated as follows:

Work = force × distance through which force is applied

W = F × L (unit of force is N, distance is in meter)

W = F (N) × L (m) = F × L (Nm)

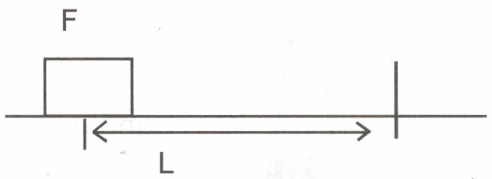


Fig: 2.3 (b)

When we do work, we use energy. Work and Energy are closely related. Work is measured in the same unit of energy.

2.7 POWER

Power is the rate of work done or rate of energy consumed. We can manually pedal a wheel of bicycle at 1 revolution per second. If we want to turn the same wheel with 10 revolutions per second, we need more power and will use engine.

The SI unit for power is watt. One **watt** is equal to 1 Newton-meter per second (Nm/s). If you were pushing on something with a force of 1 N, and it moved at a speed of 1 m/s, your power requirement would be 1 watt.

British unit of power is horsepower. The conversion is as follows:

SI: Watts (W) 1000 W=1 kW Kilowatt (kW) 1kW = 1.341 hp

Horsepower (hp) 1 hp = 0.746 kW

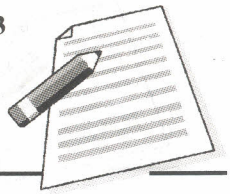
INTEXT QUESTIONS 2.2

i) Fill in the blanks:

1) Power is rate of _____ done.

2) Torque is force that tends to _____ things.

3) Work is application of _____ over a distance.



ii) Match of the following:

Parameter	Unit
Power	m/s^2
Work	N-m
Acceleration	Kg
Mass	N-m
Torque	Watt

2.8 ENERGY

Energy means invisible strength of doing work. Energy is a measure of how much work we can do. Energy needed to do certain work will always remain the same. For example energy required to lift 500lits. of water to height of 10m. will always remain the same irrespective of doing it manually or by using engine. We can only do the work faster by using engine.

Common unit of energy is the kilowatt-hour (kWh). 1 KWh energy means, one kW of power will last one hour.

There are three Main types of Energy:-

1) Kinetic Energy 2) Potential Energy (Gravitational) 3) Chemical Energy

Electrical, Heat, sound, solar, wind etc. are other examples of different forms of energy. Many times energy is invisible. It is visible by their effects. Kerosene, diesel, food, wood contains energy in the form of chemical energy. When these things burn energy comes out in the form of heat energy.

Stone falling from height (or anything in motion) contains energy. The object placed at highest place also contains hidden energy. This is called potential energy. An object in motion contains kinetic energy.

Law of Energy Conservation

Energy can neither be created nor can be destroyed. Only one form of energy can be converted to other form of energy. Energy is immortal. It is not distortable.

Energy Conversion

i) We eat food. Food contains chemical energy, in it after digestion this chemical energy is kept in the chemical form in our

body and as and when required it gets burnt and gets converted into other forms of energy.

ii) When we fetch the water from the well, the energy in the form of chemicals in our body gets converted into potential energy of water. Water will contains energy equal to the amount of work done while lifting the water.

iii) If we pour the water on the land, where the energy in it will go? If this water gets percolated in land then as it will go deep into the earth, potential energy in it will get converted into heat through friction. We never felt the heat since land is big and quantity of heat generated is comparatively smaller.

iv) When we do cycling, chemical energy from food gets converted into kinetic energy. Once cycle catches the speed then we can move with same speed without peddling. At this time our body and cycle has kinetic energy in it. When we want to get down from the cycle, we reduce the speed by pressing the breaks. Kinetic energy gets converted into heat energy by friction and the ream of the cycle becomes hot.

Whenever we change the form of energy, some amount of energy gets wasted in the form of heat. Our objective is to convert maximum amount of energy in the desired form for use. This is called as efficiency.

In diesel engine, when we burn diesel approximately 40% of energy gets converted into kinetic energy of water. When water is lifted to desire height, kinetic energy gets converted into potential energy. Remaining 60% of energy is wasted in the form of heat. This means the efficiency of diesel engine is 40%.

In the past, relation between energy and work done was not clearly understood. Therefore, units of measurement of heat and work were different. Heat was measured in terms of calories and unit of work in terms of joule. These two units are still in use because it's easier to calculate heat in calories and work in joule. We can convert calories into joule by using formula 1calorie = 4.2 joule.

Power is the rate of work done or rate of energy consumed. It tells us amount of joules used or required in one second. If one-joule energy is used in one second, then it is said that one-watt power is used.

Power (unit W watt) = J/S joule/second

= Energy used (in joule) / time taken

INTEXT QUESTIONS 2.3

i) Write down energy conversion in the following:

Electric motor	
Pump	
Diesel Engine	
Wood stove	
Solar panel	

2.9 SCALARS AND VECTORS

If someone ask you a Questions, 'How far is Mumbai?' to locate Mumbai on a map. What answer will satisfy him? You will need to know the distance in Kilometers and the direction.

But if I ask what is the temperature of the object? Or how many people live there. you need only one number to get the full information. The distance to Bombay is not complete information without giving the direction of that measurement. But the temperature, say 35° C is complete and unambiguous information. Temperature is called Scalar (independent of direction). The quantities like distance needs the direction to become complete are called Vectors(dependent of direction).

The 3-D Space

All the objects in the universe have 3 dimensions; they have length, breadth and height. A line has only one dimension-length. An area has two dimensions i.e. breadth and length. A solid object has 3 dimensions. (ref. fig-5) So when we measure a distance, we need to know which direction we have measured.

There are four main directions. East, West, North and South. There is also up and down directions.

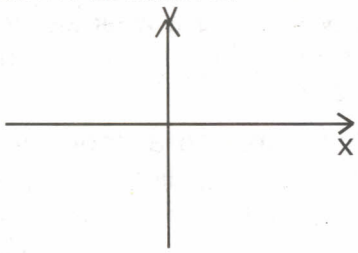


Fig: 2.4 Directions

There are also direction in between the two, north-east, south-west. This way there can be many directions, really infinite number.

There can be one in between any given two.

Two directions which are at right angles to each other are considered separate, because movement in one direction does not affect the position in the other. In a graph, change in the X directions does not change the Y-value.

Similarly, change in the Y-direction does not change the position in the X- direction. And we say X and Y are two 'orthogonal' directions (fig.4)

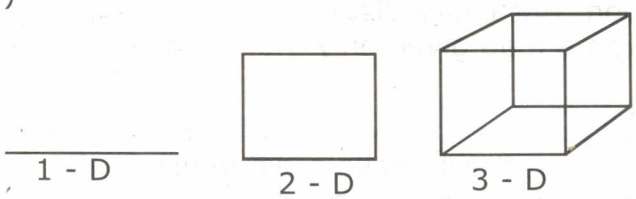


Fig: 2.5 Various dimensions

In this sense our space has three dimensions because we can draw only three orthogonal directions, not more (ref. fig.6)

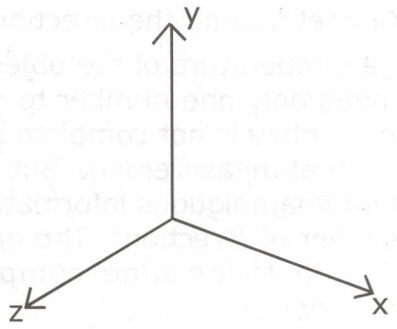


Fig: 2.6

DEFINING SCALE AND VECTOR

How do we know if a quantity is scalar (independent of direction) or vector (dependent on direction)? In simple language, if the direction is changed it must make a difference that we can experience.

i) *Distance:* If one goes 1 km for a walk every day, will he reach the same place, every time? Of course not, it depends on the direction. So distance is a vector.

ii) *Force:* If you apply a force to a door, will it open or close? It depends on the direction in which you apply the force. Pulling and pushing is not the same. So force is a vector.

iii) *Area:* You are going with an open umbrella in a storm. How do you hold the umbrella? For the same wind force, the direction of the umbrella makes a difference. It may even turn inside out. The sail of a boat has to be turned in a proper direction to use the wind to best advantage, So area is also a vector.

iv) *Temperature, weight and Colour* are not vectors.

v) *Volume:* If you measure 5 liters it makes no difference what the direction is. Volume is a quantity that involves all three dimensions so nothing more to tell. Volume is a scalar.

In conventional books, distance is called a scalar and Displacement is called a vector. There is no fundamental difference between distance and displacement. Displacement is a distance in a definite direction. But every distance has a direction. You cannot locate a town on a map given only a distance. Therefore distance is a vector.

All units based on a vector will also be vectors, because if the direction is changed, it will make a difference in the other vector also. Thus area, force, velocity etc are vectors.

INTEXT QUESTIONS 2.4

i) Write down if following parameters are scalar or vector.

Mass, distance, velocity, volume, temperature, area, force, colour

Addition of Vector

We cannot add things which are different. How much is 5 mangos + 2 apples? It will be 5 mangoes + 2 apples. If we ask the same Questions by calling them fruit, then we can add and we have 7 fruit.

Similarly, we can add 2 cms + 1 inch only if we bring them to a common unit form. 1 Inch is 2.5 cm so 2 cm + 1 inch(2.5 cm) is 4.5 cm.

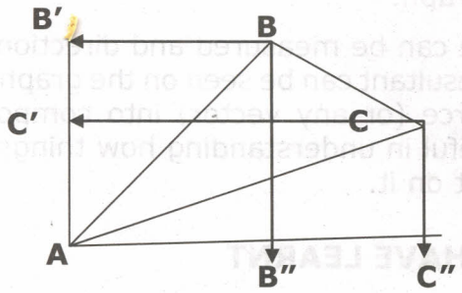


Fig: 2.7

Vectors in different directions are like quantities in different units. You can add them only when they are in the same direction. But how do we do this?

In fig 7 a force AB and AC are acting on a point A. They are vectors. They can be added only after they are made in the same form. To make them in the same form, we break up each into its components in the X and Y directions. To do this we take projections (shadows in simple parlance) on the X and Y axis. Projection of B on x axis is B" and on Y Axis it is B′. Similarly projection C on X axis is C" and on Y axis is C′.

When we apply force, it may have effects in different directions. In real life, we apply forces in different direction, projection of these vectors on X and Y direction is taken to predict result of forces.

Let us see an example:

Two people A and B are pulling on a rope, tied to a tree. A is applying 20N force and B is applying 30N force. Both of them are applying force in 90° of each other. How much force does have and which direction?

If forces A and B are applied in the directions shown, the resulting force, the sum of A and B will be as if a single force is applied in the direction marked 'Resultant'.