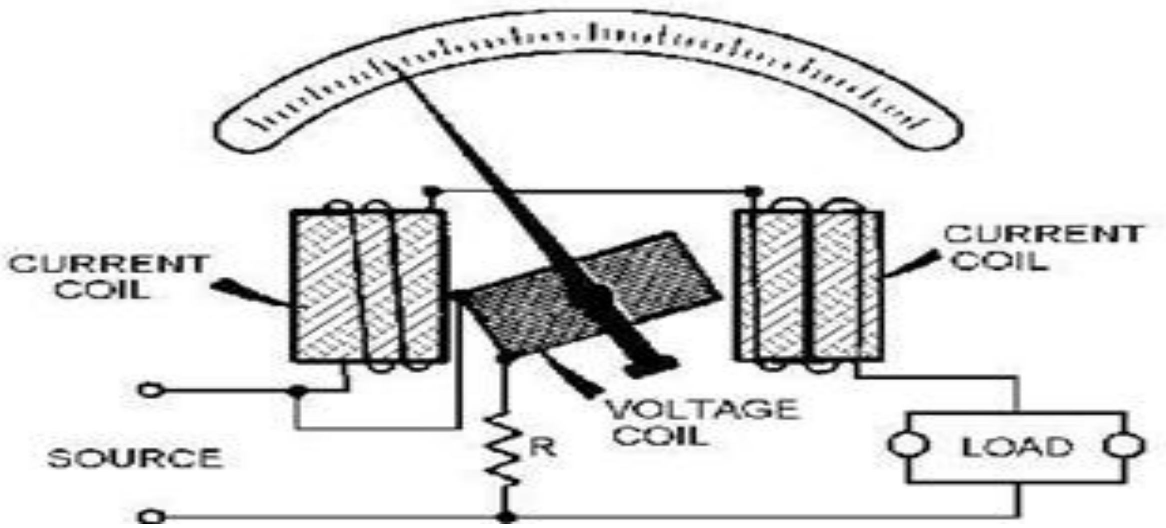
UNIT – IV
ENERGY INSTRUMENTS

wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, PLCs and applications.

Wattmeter

Construction of a Wattmeter: The mechanical construction of a wattmeter is shown in the figure below.



- The needle that is supposed to move on the marked scale to indicate the amount of power is also attached to the potential coil. The reason for this is that the potential coil is allowed to move whereas the current coil is kept fixed.
- The internal construction of a wattmeter is such that it consists of two cols. One of the coil is in series and the other is connected in parallel. The coil that is connected in series with the circuit is known as the current coil and the one that is connected in parallel with the circuit is known as the voltage coil.

Data Loggers

Introduction

What is data logging?

It is the process of using a computer to collect data through sensors, analyze the data and save and output the results of the collection and analysis.

Data logging is commonly used in scientific experiments and in monitoring systems.

DATA LOGGER

A data logger (also data logger or data recorder) is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors.

They generally are small, battery powered, portable and equipped with a microprocessor, internal memory for data storage and sensors.

Some data loggers interface with a personal computer and utilize software to activate the data logger and view and analyze the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device.

The sensors may communicate with the logger through a cable or wireless link and may sense temperature, humidity pressure flow, wind speed, current, voltage, resistance and most of other physical parameters that are important in monitoring and controlling processes.

One of the primary benefits of using data loggers is the ability to automatically collect data on a 24-hour basis.

DATA LOGGING Vs DATA ACQUISITION

The term data logging and data acquisition are used interchangeably.

However in historical context they are quite different.

A data logger is a data acquisition system, but a data acquisition system is not necessarily a data logger.

Data loggers typically have slower sample rates.

APPLICATIONS

Soil moisture level recording

Road traffic counting

Vehicle testing

Monitoring of relays status in railway signaling

THERMOCOUPLES

Introduction

In electrical engineering and industry, thermocouples are widely used temperature sensors.

They are cheap and interchangeable standard connectors, and can measure a wide range of temperatures.

Thermocouples alloys are commonly available as wires.

What is thermocouple sensor?

A thermocouple is a thermocouple device used to measure temperatures accurately.

It consists of two dissimilar metals having different thermal and electrical properties joined together at one end so that potential difference generated between the contact points measures the temperature.

Principle of operation:

The principle is that when one junction is heated, an EMF is produced causing a current to flow round the loop. The EMF generated is given by logE = Alogt+B

Where t = temperature and A& B are constants depending upon the wires forming the junction.

Thermocouples Types:

A Thermocouple is available in different combinations of metals or calibrations.

The four most common calibrations are J, K, and T & E.

The high temperature calibrations are R, S, and C & GB.

Other types of Thermocouples include beaded wire Thermocouple & Thermocouple probe.

How do we choose a Thermocouple type?

Thermocouples are very often used in industry as they are simple & can be used to measure wide range of temperatures

The following criteria are used in selecting a thermocouple:

Temperature range
Chemical resistance of thermocouple (or) sheath material.
Vibration resistance
Installation requirements.

Type K

Type K (chromel {90% nickel and 10% chromium}—alumel {95% nickel, 2% manganese, 2% aluminium and 1% silicon}) is the most common general purpose thermocouple with a sensitivity of approximately 41 µV/°C, chromel positive relative to alumel.[9] It is inexpensive, and a wide variety of probes are available in its −200 °C to +1250 °C / -330 °F to +2460 °F range. Type K was specified at a time when metallurgy was less advanced than it is today, and consequently characteristics may vary considerably between samples. One of the constituent metals, nickel, is magnetic; a characteristic of thermocouples made with magnetic material is that they undergo a deviation in output when the material reaches its Curie point; this occurs for type K thermocouples at around 350 °C. Wire color standard is yellow (+) and red (-).

It is the most commonly used for general purpose thermocouples.

It is inexpensive and available in wide variety or probes.

They are available in -2000C to 13500C range.

Type E

Type E (chromel–constantan) has a high output (68 µV/°C) which makes it well suited to cryogenic use. Additionally, it is non-magnetic. Wide range is −50 to 740 °C and Narrow range is −110 to 140 °C. Wire color standard is purple (+) and red (-).

It has high output (68µv/0C) which makes it well suited for no. of applications.

Type J

Type J (iron–constantan) has a more restricted range than type K (−40 to +750 °C), but higher sensitivity of about 55 µV/°C. The Curie point of the iron (770 °C) causes an abrupt change in the characteristic, which determines the upper temperature limit. Wire color standard is white (+) and red (-).

It is less popular than K due to its limited range (-400C to 7500C)

Type T

Type T (copper – constantan) thermocouples are suited for measurements in the −200 to 350 °C range. Often used as a differential measurement since only copper wire touches the probes. Since both conductors are non-magnetic, there is no Curie point and thus no abrupt change in characteristics. Type T thermocouples have a sensitivity of about 43 µV/°C.

It is available in the range of -2000C to 3500C.

COMMON THERMOCOUPLE TEMPARATURE RANGES

Calibration	Temperature range	Standard. limits of error	Specific. Limits of error
J	0^0C to 750^0C	Greater than 2.2^0C	Greater than 1.1^0C
K	-200^0C to 1250^0C	Greater than 2.2^0C	Greater than 1.1^0C
E	-200^0C to 900^0C	Greater than 1.7^0C	Greater than 1.0^0C
T	-250^0C to 350^0C	Greater than 1.0^0C	Greater than 0.5^0C

Advantages & Disadvantages

Advantages

1. These are cheaper than the resistance thermometers.

2. These are very convenient for measuring the temperature at one particular point in a piece of apparatus.

Disadvantages

1. They have lower accuracy.

2. Complex Circuitry.

Applications

Thermocouples are most suitable for measuring over a large temperature range up to 1800_0C.

They are used as relays and also as protective devices in starters etc.

Type	Temperature range °C (continuous)	Temperature range °C (short term)	Tolerance class one (°C)	Tolerance class two (°C)	IEC Color code	BS Color code	ANSI Color code
K	0 to +1100	−180 to +1300	±1.5 between −40 °C and 375 °C ±0.004×T between 375 °C and 1000 °C	±2.5 between −40 °C and 333 °C ±0.0075×T between 333 °C and 1200 °C			
J	0 to +750	−180 to +800	±1.5 between −40 °C and 375 °C ±0.004×T between 375 °C and 750 °C	±2.5 between −40 °C and 333 °C ±0.0075×T between 333 °C and 750 °C			
N	0 to +1100	−270 to +1300	±1.5 between −40 °C and 375 °C ±0.004×T between 375 °C and 1000 °C	±2.5 between −40 °C and 333 °C ±0.0075×T between 333 °C and 1200 °C			
R	0 to +1600	−50 to +1700	±1.0 between 0 °C and 1100 °C ±[1 + 0.003×(T − 1100)] between 1100 °C and 1600 °C	±1.5 between 0 °C and 600 °C ±0.0025×T between 600 °C and 1600 °C			Not defined.
S	0 to +1600	−50 to +1750	±1.0 between 0 °C and 1100 °C ±[1 + 0.003×(T − 1100)] between 1100 °C and 1600 °C	±1.5 between 0 °C and 600 °C ±0.0025×T between 600 °C and 1600 °C			Not defined.
B	+200 to +1700	0 to +1820	Not Available	±0.0025×T between 600 °C and 1700 °C	No standard use copper wire	No standard use copper wire	Not defined.
T	−185 to +300	−250 to +400	±0.5 between −40 °C and 125 °C ±0.004×T between 125 °C and 350 °C	±1.0 between −40 °C and 133 °C ±0.0075×T between 133 °C and 350 °C			
E	0 to +800	−40 to +900	±1.5 between −40 °C and 375 °C ±0.004×T between 375 °C and 800 °C	±2.5 between −40 °C and 333 °C ±0.0075×T between 333 °C and 900 °C			

PYROMETER

Introduction

Pyrometer is any non-contacting device that intercepts and measures thermal radiation.

This measure is used to determine temperature, often of the object's surface.

Pyrometer was originally coined to denote a device capable of measuring temperatures of objects above incandescence (i.e. objects bright to human eye).

Pyrometer is used for measurement of high temperature.

RADIATION PYROMETER

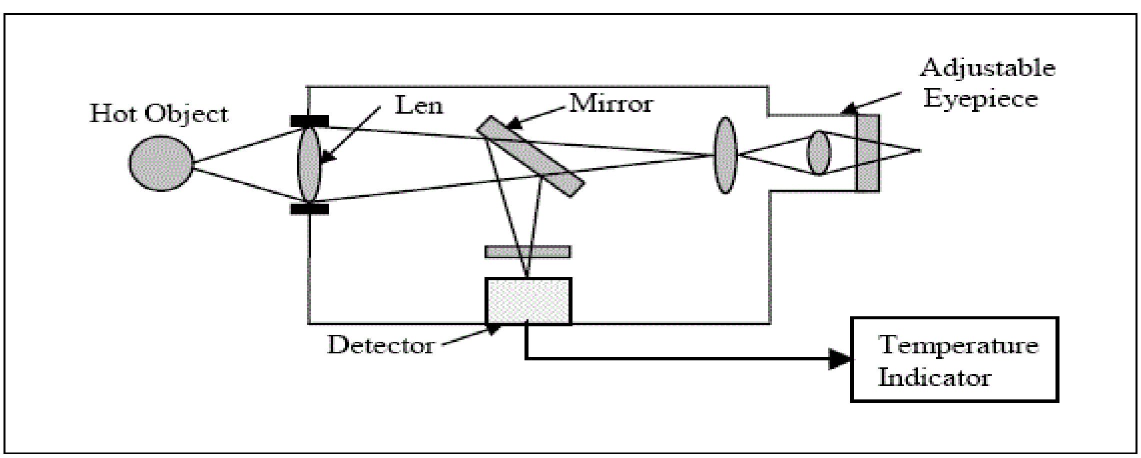


Figure Block diagram of radiation pyrometer

Optical pyrometers work on the basic principle of using the human eye to match the brightness of the hot object to the brightness of a calibrated lamp filament inside the instrument.

The optical system contains filters that restrict the wavelength-sensitivity of the devices to a narrow wavelength band around 0.65 to 0.66 micons.

APPLICATIONS

Pyrometers are suited especially to the measurement of moving objects (or) any surfaces that can't be reached (or) can't be touched.

Pyrometers are used to measure wide temperature ranges above 17000C.

LUX METER

Lux meters (or) Light meters measures illumination in terms of luxes (lx).

A Lux is equal to the total intensity of light that falls on a one square meter surface i.e., one foot away from the point source of light.

Most lux meters consist of a body, light sensor & display.

The light that falls on to the light sensor contains energy i.e., converted to electric current.

In turn the amount of current depends on the amount of light that strikes the light sensor.

Lux meter read the electrical current, calculate the appropriate value and output the result to an analog, digital (or) video display.

The light usually contains different colors at different wavelengths; the reading represents the combined effects of all the wavelengths.

Typically standard colors (or) colors temperature are expressed in degrees klv.

The standard color temperatures for the calibration of most lux meters is 28560K

Selecting lux meter requires an analysis of performance specifications, display types

& special features.

Performance specifications include sensor diameter, illumination range, accuracy, lux resolution, humidity range and optimum temperature range.

Several display types are available i.e. Analog devices display values on a dial usually with a needle (or) pointer.

Digital devices display values as numbers or letters.

Some lux meters are portable, handheld devices other are designed to sit atop desk or bench top.

Tongue testers

In electrical and electronic engineering, a **current clamp** or **current probe** is an electrical device having two jaws which open to allow clamping around an electrical conductor. This allows properties of the electric current in the conductor to be measured, without having to make physical contact with it, or to disconnect it for insertion through the probe. Current clamps are usually used to read the magnitude of a sinusoidal current (as invariably used in alternating current (AC) power distribution systems), but in conjunction with more advanced instrumentation the phase and waveform are available. Very high alternating currents (1000 A and more) are easily read with an appropriate meter; direct currents, and very low AC currents (milliamperes) are more difficult to measure.

Types of current clamp

Current transformer

A common form of current clamp comprises a split ring made of ferrite or soft iron. A wire coil is wound round one or both halves, forming one winding of a current transformer. The conductor around which it is clamped forms the other winding. Like any transformer this type works only with AC or pulse waveforms, with some examples extending into the megahertz range.

When measuring current, the subject conductor forms the primary winding and the coil forms the secondary.

This type may also be used in reverse, to inject current into the conductor, for example in EMC susceptibility testing to induce an interference current. Usually, the injection probe is specifically designed for this purpose. In this mode, the coil forms the primary and the test conductor the secondary.

Iron vane

In the iron vane type, the magnetic flux in the core directly affects a moving iron vane, allowing both AC and DC to be measured, and gives a true RMS value for non-sinusoidal AC waveforms. Due to its physical size it is generally limited to power transmission frequencies up to around 100 Hz.

The vane is usually fixed directly to the display mechanism of an analogue (moving pointer) clamp meter.

Hall Effect

The Hall Effect type is more sensitive and is able to measure both DC and AC, in some examples up to the kilohertz (thousands of hertz) range. This type was often used with oscilloscopes, and with high-end computerized digital multimeters, however, they are becoming common place for more general use.

Multi-conductor

Traditional current clamps will only work if placed around one conductor of the circuit under test because if it is placed around both, the magnetic fields would cancel. A relatively recent development is a clamp meter that has several sensor coils around the jaws of the clamp. This type can be clamped around standard 2 or 3 conductor single phase cables and will provide readout of the current flowing through the load. A version for three phase circuits does not currently exist, but in such circuits the individual conductors are usually accessible.

Clamp meter

An electrical meter with integral AC current clamp is known as a clamp meter, clamp-on ammeter or tong tester.

In order to use a clamp meter, only one conductor is normally passed through the probe; if more than one conductor is passed through then the measurement would be the vector sum of the currents flowing in the conductors and would depend on the phase relationship of the currents. In particular if the clamp is closed around a two-conductor cable carrying power to equipment the same current flows down one conductor and up the other, with a net current of zero. Clamp meters are often sold with a device that is plugged in between the power outlet and the device to be tested. The device is essentially a short extension cord with the two conductors separated, so that the clamp can be placed around only one conductor.

The reading produced by a conductor carrying a very low current can be increased by winding the conductor around the clamp several times; the meter reading divided by the number of turns is the current, with some loss of accuracy due to inductive effects.

Clamp meters are used by electricians, sometimes with the clamp incorporated into a general purpose multimeter.

It is simple to measure very high currents (hundreds of amperes) with the appropriate current transformer. Accurate measurement of low currents (a few milliamperes) with a current transformer clamp is more difficult.

An iron vane type clamp-on ammeter

Less-expensive clamp meters use a rectifier circuit which actually reads mean current, but is calibrated to display the RMS current corresponding to the measured mean, giving a correct RMS reading only if the current is a sine wave. For other waveforms readings will be incorrect; when these simpler meters are used with non-sinusoidal loads such as the ballasts used with fluorescent lamps or high-intensity discharge lamps or most modern computer and electronic equipment, readings can be quite inaccurate. Meters which respond to true RMS rather than mean current are described as "true RMS".

Typical hand-held Hall Effect units can read currents as low as 200 mA, and units that can read down to 1 mA are available.

The Columbia tong test ammeter, manufactured by Weschler Instruments, is an example of the iron vane type, used for measuring large AC currents up to 1000 amperes. The iron jaws of the meter direct the magnetic field surrounding the conductor to an iron vane that is attached to the needle of the meter. The iron vane moves in proportion to the strength of the magnetic field, and thus produces a meter indication proportional to the current. This type of ammeter can measure both AC and DC currents and provides a true RMS current measurement of non-sinusoidal or distorted AC waveforms. Interchangeable meter movements can be installed in the clamping assembly to provide various full-scale current values up to 1000 amperes. The iron vane is in a small cylinder that is inserted in a space at the hinged end of the clamp-on jaws. Several jaw sizes are available for clamping around large conductors and bus bars up to 41⁄2 inches (110 mm) wide.

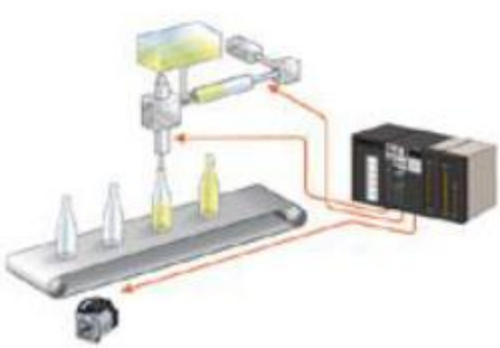
Power meter, energy analyzer

Clamp meters are used in some meters to measure electrical power and energy. The clamp measures the current and other circuitry the voltage; the true power is the product of the instantaneous voltage and current integrated over a cycle. Comprehensive meters designed to measure many parameters of electrical energy (power factor, distortion, instantaneous power as a function of time, phase relationships, etc.), energy analyzers, use this principle. With an appropriate instrument measurements may be made on three-phase, as well as single-phase, power systems.

Application of PLC's PLC applications found:

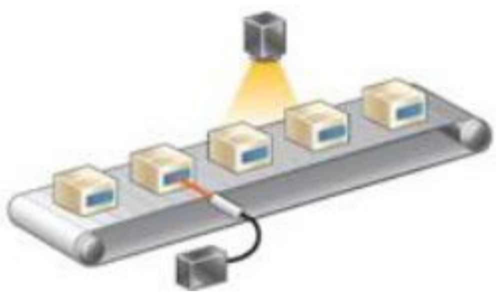
High-precision Synchronized Control in Crimping Equipment using PLC

Bottle Filling Control using PLC



High-speed Sorting on Conveyors using PLC

Image-processing Inspection of Electronic Components using PLC

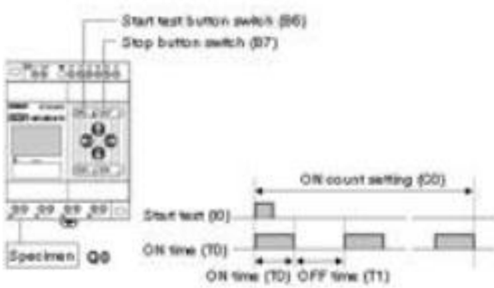


Shopping Mall Fountain Control using PLC

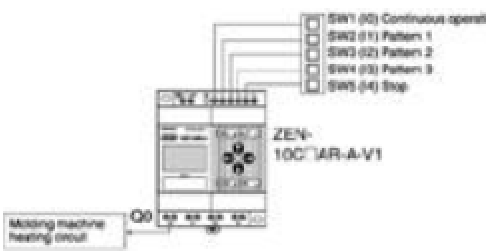
Air Cleaner Control using PLC

Sheet Feeding Control in Packing Machine using PLC

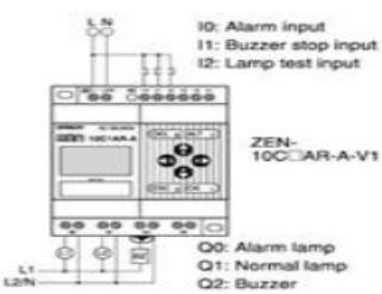
Testing Equipment



Warming Moulding Machines



Annunciator



ENERGY ECONOMIC ANALYSIS

The time value of money concept, Cash flow models, payback analysis, depreciation, taxes and tax credit - numerical problems.

The time value of money concept

Money has time value. A rupee today is more valuable than a year hence. It is on this concept "the time value of money" is based. The recognition of the time value of money and risk is extremely vital in financial decision making.

REASONS FOR TIME VALUE OF MONEY

Money has time value because of the following reasons:

1. Risk and Uncertainty: Future is always uncertain and risky. Outflow of cash is in our control as payments to parties are made by us. There is no certainty for future cash inflows. Cash inflows is dependent out on our Creditor, Bank etc. As an individual or firm is not certain about future cash receipts, it prefers receiving cash now.

2. Inflation: In an inflationary economy, the money received today, has more purchasing power than the money to be received in future. In other words, a rupee today represents a greater real purchasing power than a rupee a year hence.

3. Consumption: Individuals generally prefer current consumption to future consumption.

4. Investment opportunities: An investor can profitably employ a rupee received today, to give him a higher value to be received tomorrow or after a certain period of time.

Thus, the fundamental principle behind the concept of time value of money is that, a sum of money received today, is worth more than if the same is received after a certain period of time. For example, if an individual is given an alternative either to receive `10,000 now or after one year, he will prefer `10,000 now. This is because, today, he may be in a position to purchase more goods with this money than what he is going to get for the same amount after one year.

Thus, time value of money is a vital consideration in making financial decision. Let us take some examples:

EXAMPLE 1:A project needs an initial investment of `1,00,000. It is expected to give a return of `20,000 per annum at the end of each year, for six years. The project thus involves a cash outflow of `1,00,000 in the 'zero year' and cash inflows of `20,000 per year, for six years. In order to decide, whether to accept or reject the project, it is necessary that the Present Value of cash inflows received annually for six years is ascertained and compared with the initial investment of `1,00,000. The firm will accept the project only when the Present Value of cash inflows at the desired rate of interest exceeds the initial investment or at least equals the initial investment of `1,00,000.

EXAMPLE2: A firm has to choose between two projects. One involves an outlay of `10 lakhs with a return of 12% from the first year onwards, for ten years. The other requires an investment of `10 lakhs with a return of 14% per annum for 15 years commencing with the beginning of the sixth year of the project. In order to make a choice between these two projects, it is necessary to compare the cash outflows and the cash inflows resulting from the project. In order to make a meaningful comparison, it is necessary that the two variables are strictly comparable. It is possible only when the time element is incorporated in the relevant calculations. This reflects the need for comparing the cash flows arising at different points of time in decision-making.

VALUATION CONCEPTS

The time value of money establishes that there is a preference of having money at present than a future point of time. It means (a) That a person will have to pay in future more, for a rupee received today. For example: Suppose your father gave you `100 on your tenth birthday. You deposited this amount in a bank at 10% rate of interest for one year. How much future sum would you receive after one year? You would receive `110

Future sum = Principal + Interest

$= 100 + 0.10 \times 100$

= `110

What would be the future sum if you deposited `100 for two years? You would now receive interest on interest earned after one year.

Future sum = 100×1.10

2

=`121

We express this procedure of calculating as Compound Value or Future Value of a sum.

(b) A person may accept less today, for a rupee to be received in the future. Thus, the inverse of compounding process is termed as discounting. Here we can find the value of future cash flow as on today.

TECHNIQUES OF TIME VALUE OF MONEY

There are two techniques for adjusting time value of money. They are:

1. Compounding Techniques/Future Value Techniques

2. Discounting/Present Value Techniques

The value of money at a future date with a given interest rate is called future value. Similarly, the worth of money today that is receivable or payable at a future date is called Present Value.

Compounding Techniques/Future Value Technique

In this concept, the interest earned on the initial principal amount becomes a part of the principal at the end of the compounding period.

FOR EXAMPLE: Suppose you invest `1000 for three years in a saving account that pays 10 per cent interest per year. If you let your interest income be reinvested, your investment will grow as follows

First year :	Principal at the beginning	1,000
	Interest for the year (₹ 1,000 × 0.10)	100
	Principal at the end	1,100
Second year :	Principal at the beginning	1,100
	Interest for the year (₹ 1,100 × 0.10)	110
	Principal at the end	1210
Third year :	Principal at the beginning	1210
	Interest for the year (₹ 1210 × 0.10)	121
	Principal at the end	1331

This process of compounding will continue for an indefinite time period.

The process of investing money as well as reinvesting interest earned there on is called Compounding. But the way it has gone about calculating the future value will prove to be cumbersome if the future value over long maturity periods of 20 years to 30 years is to be calculated. A generalised procedure for calculating the future value of a single amount compounded annually is as follows:

Formula: $\boxed{FV_n = PV(1 + r)^n}$

In this equation $(1 + r)^n$ is called the future value interest factor (FVIF).

where, FV_n = Future value of the initial flow n year hence

PV = Initial cash flow

r = Annual rate of Interest

n = number of years

By taking into consideration, the above example, we get the same result.

$$FV_n = PV\,(1 + r)^n$$

$$= 1{,}000\ (1.10)^3$$

$$FV_n = 1331$$

FUTURE VALUE OF MULTIPLE CASH FLOWS

The above illustration is an example of multiple cash flows.

The transactions in real life are not limited to one. An investor investing money in instalments may wish to know the value of his savings after '*n*' years. The formulae is

$$FV_n = PV\left(1+\frac{r}{m}\right)$$

where FV_n = Future value after '*n*' years

PV = Present value of money today

r = Interest rate

m = Number of times compounding is done in a year.

ILLUSTRATION 5:

(*i*) A company offers 12% rate of interest on deposits. What is the effective rate of interest if the compounding is done on

(*a*) Half-yearly

(*b*) Quarterly

(*c*) Monthly

(*ii*) As an alternative, the following rates of interest are offered for choice. Which basis gives the highest rate of interest that is to be accepted?

Basis of Compounding	Interest Rate
Yearly	12%
Half-yearly	11.75%
Quarterly	11.50%
Monthly	11.25%

SOLUTION:

(*i*) The formula for calculation of effective interest is as below:

$$EIR = \left(1 + \frac{r}{m}\right) - 1$$

(*A*) When the compounding is done on half-yearly basis:

$$EIR = \left[\left(1 + \frac{.12}{2}\right)^2 - 1\right]$$

$$= 1.1236 - 1$$

$$= 12.36\%$$

(*B*) When the compounding is done on quarterly basis

$$EIR = \left[1 + \frac{.12}{4}\right]^4 - 1$$

$$= 0.1255$$

$$= 12.55\%$$

(*C*) When the compounding is done on monthly basis

$$EIR = \left[1 + \frac{.12}{12}\right]^{12} - 1$$

Basis of Compounding	Interest Rate	EIR
Yearly	12%	12%
Half-yearly	12%	12.36%
Quarterly	12%	12.55%
Monthly	12%	12.68%

(*ii*) When the compounding is done on half-yearly basis

$$EIR = \left[1 + \frac{.1175}{2}\right]^2 - 1$$
$$= 0.1209$$
$$= 12.09\%$$

When the compounding is done on quarterly basis:

$$EIR = \left[1 + \frac{0.1150}{4}\right]^4 - 1$$
$$= .1200$$
$$= 12\%$$

When the compounding is done on monthly basis

$$EIR = \left[1 + \frac{0.1125}{12}\right]^{12} - 1$$
$$= 0.1184$$
$$= 11.84\%$$

Thus, out of all interest rate, interest rate of 11.75% on half-yearly compounding works out to be the highest effective interest rate *i.e.*, 12.09% so this option is to be accepted.

ILLUSTRATION 6: Find out the effective rate of interest, if nominal rate of interest is 12% and is quarterly compounded.

SOLUTION:

$$EIR = \left[\left(1+\frac{r}{m}\right)^m - 1\right]$$

$$= \left[\left(1+\frac{.12}{4}\right)^4 - 1\right]$$

$$= [(1 + 0.03)^4 - 1]$$

$$= 1.126 - 1$$

$$= 0.126$$

$$= 12.6\% \text{ p.a.}$$

Growth Rate

The compound rate of growth for a given series for a period of time can be calculated by employing the future value interest factor table (*FVIF*)

EXAMPLE:

Years	Profit (in Lakhs)
1	95
2	105
3	140
4	160
5	165
6	170

How is the compound rate of growth for the above series determined? This can be done in two steps:

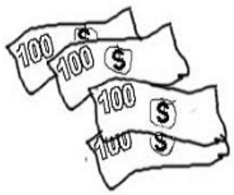
(*i*) The ratio of profits for year 6 to year 1 is to be determined *i.e.*,

$$\frac{170}{95} = 1.79$$

(*ii*) The $FVIF_{r,n}$ table is to be looked at. Look at a value which is close to 1.79 for the row for 5 years. The value close to 1.79 is 1.762 and the interest rate corresponding to this is 12%. Therefore, the compound rate of growth is 12 per cent.

Developing cash flow models

Basic Cash Flow Model



- A Cash Flow projection is an estimate of cash generated from the project over a period of time. It is not just the initial cash returned.

- Cash Flow (CF) is basically the cash available after all expenses are paid. Cash Flow analysis considers the coverage of expenses and debt service. Debt service consists of the principal and interest payments. The money that remains after paying such expenses is the Cash Flow.

A summarized Cash Flow schedule for an Income Property for one year could be as follows:

	Gross Income (Gross Revenue)	**$ 200,000**
less:	**Losses (or bad debts)**	**2,000**
plus:	**miscellaneous income**	**1,000**
equal:	**Effective Gross Income**	**199,000**
less:	**Operating Expenses**	**70,000**
less:	**Replacement Reserve**	**10,000**
equal:	**Net Operating Income**	**119,000**
less:	**Interest**	**75,000**
less:	**Principal payment**	**8,250**
equal:	**Cash Flow**	**$ 35,750**

Note: For Cash Flow projections of a new development, losses would not be appropriate but Brokerage Commissions paid on lot sales would be deducted from Gross Income. Instead of Replacement Reserves, a Cash Flow projection for a new development would consider Contingency Funds. This Cash Flow model is a Before Tax model.

Discounted cash flow

In finance, **discounted cash flow** (**DCF**) analysis is a method of valuing a project, company, or asset using the concepts of the time value of money. All future cash flows are estimated and discounted to give their present values (PVs) — the sum of all future cash flows, both incoming and outgoing, is the net present value (NPV), which is taken as the value or price of the cash flows in question.

Using DCF analysis to compute the NPV takes as input cash flows and a discount rate and gives as output a price; the opposite process — taking cash flows and a price and inferring a discount rate, is called the yield.

Discounted cash flow analysis is widely used in investment finance, real estate development, and corporate financial management.

Discount rate

The most widely used method of discounting is exponential discounting, which values future cash flows as "how much money would have to be invested currently, at a given rate of return, to yield the cash flow in future." Other methods of discounting, such as hyperbolic discounting, are studied in academia and said to reflect intuitive decision-making, but are not generally used in industry.

The discount rate used is generally the appropriate Weighted average cost of capital (WACC), that reflects the risk of the cashflows. The discount rate reflects two things:

1. The time value of money (risk-free rate) – according to the theory of time preference, investors would rather have cash immediately than having to wait and must therefore be compensated by paying for the delay.

2. A risk premium – reflects the extra return investors demand because they want to be compensated for the risk that the cash flow might not materialize after all.

Discounted cash flows

The discounted cash flow formula is derived from the future value formula for calculating the time value of money and compounding returns.

$$DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n}$$
$$FV = DCF \cdot (1+i)^n$$

Thus the discounted present value (for one cash flow in one future period) is expressed as:

$$DPV = \frac{FV}{(1+i)^n} = FV(1+d)^-n$$

where

 DPV is the discounted present value of the future cash flow (*FV*), or *FV* adjusted for the delay in receipt;

 FV is the nominal value of a cash flow amount in a future period;

 i is the interest rate, which reflects the cost of tying up capital and may also allow for the risk that the payment may not be received in full;

 d is the discount rate, which is *i*/(1+*i*), i.e. the interest rate expressed as a deduction at the beginning of the year instead of an addition at the end of the year;

 n is the time in years before the future cash flow occurs.

Where multiple cash flows in multiple time periods are discounted, it is necessary to sum them as follows:

$$DPV = \sum_{t=0}^{N} \frac{FV_t}{(1+i)^t}$$

for each future cash flow (*FV*) at any time period (*t*) in years from the present time, summed over all time periods. The sum can then be used as a net present value figure. If the amount to be paid at time 0 (now) for all the future cash flows is known, then that amount can be substituted for *DPV* and the equation can be solved for *i*, that is the internal rate of return.

All the above assumes that the interest rate remains constant throughout the whole period.

Continuous cash flows

For continuous cash flows, the summation in the above formula is replaced by an integration:

$$DPV = \int_0^T FV(t)\, e^{-\lambda t} dt\ ,$$

where *FV*(*t*) is now the *rate* of cash flow, and $\lambda = \log(1+i)$.

Example DCF

To show how discounted cash flow analysis is performed, consider the following simplified example.

- John Doe buys a house for $100,000. Three years later, he expects to be able to sell this house for $150,000.

Simple subtraction suggests that the value of his profit on such a transaction would be $150,000 − $100,000 = $50,000, or 50%. If that $50,000 is amortized over the three years, his implied annual return (known as the internal rate of return) would be about 14.5%. Looking at those figures, he might be justified in thinking that the purchase looked like a good idea.

(1.145)^3 x 100000 = 150000 approximately.

However, since three years have passed between the purchase and the sale, any cash flow from the sale must be discounted accordingly. At the time John Doe buys the house, the 3-year US Treasury Note rate is 5% per annum. Treasury Notes are generally considered to be inherently less risky than real estate, since the value of the Note is guaranteed by the US Government and there is a liquid market for the purchase and sale of T-Notes. If he hadn't put his money into buying the house, he could have invested it in the relatively safe T-Notes instead. This 5% per annum can therefore be regarded as the risk-free interest rate for the relevant period (3 years).

Using the DPV formula above (FV=$150,000, i=0.05, n=3), that means that the value of $150,000 received in three years actually has a present value of $129,576 (rounded off). In other words we would need to invest $129,576 in a T-Bond now to get $150,000 in 3 years almost risk free. This is a quantitative way of showing that money in the future is not as valuable as money in the present ($150,000 in 3 years isn't worth the same as $150,000 now; it is worth $129,576 now).

Subtracting the purchase price of the house ($100,000) from the present value results in the net present value of the whole transaction, which would be $29,576 or a little more than 29% of the purchase price.

Another way of looking at the deal as the excess return achieved (over the risk-free rate) is (114.5 - 105)/(100 + 5) or approximately 9.0% (still very respectable).

But what about risk?

We assume that the $150,000 is John's best estimate of the sale price that he will be able to achieve in 3 years time (after deducting all expenses, of course). There is of course a lot of uncertainty about house prices, and the outcome may end up higher or lower than this estimate.

(The house John is buying is in a "good neighborhood," but market values have been rising quite a lot lately and the real estate market analysts in the media are talking about a slow-down and higher interest rates. There is a probability that John might not be able to get the full $150,000 he is expecting in three years due to a slowing of price appreciation, or that loss of liquidity in the real estate market might make it very hard for him to sell at all.)

Under normal circumstances, people entering into such transactions are risk-averse, that is to say that they are prepared to accept a lower expected return for the sake of avoiding risk. See Capital asset pricing model for a further discussion of this. For the sake of the example (and this is a gross simplification), let's assume that he values this particular risk at 5% per annum (we could perform a more precise probabilistic analysis of the risk, but that is beyond the scope of this article). Therefore, allowing for this risk, his expected return is now 9.0% per annum (the arithmetic is the same as above).

And the excess return over the risk-free rate is now (109 - 105)/(100 + 5) which comes to approximately 3.8% per annum.

That return rate may seem low, but it is still positive after all of our discounting, suggesting that the investment decision is probably a good one: it produces enough profit to compensate for tying up capital and incurring risk with a little extra left over. When investors and managers perform DCF analysis, the important thing is that the net present value of the decision after discounting all future cash flows at least be positive (more than zero). If it is negative, that means that the investment decision would actually *lose* money even if it appears to generate a nominal profit. For instance, if the expected sale price of John Doe's house in the example above was not $150,000 in three years, but *$130,000* in three years or $150,000 in *five* years, then on the above assumptions buying the house would actually cause John to *lose* money in present-value terms (about $3,000 in the first case, and about $8,000 in the second). Similarly, if the house was located in an undesirable neighborhood and the Federal Reserve Bank was about to raise interest rates by five percentage points, then the risk factor would be a lot higher than 5%: it might not be possible for him to predict a profit in discounted terms even if he thinks he could sell the house for *$200,000* in three years.

In this example, only one future cash flow was considered. For a decision which generates multiple cash flows in multiple time periods, all the cash flows must be discounted and then summed into a single net present value.

Payback analysis

Payback period in capital budgeting refers to the period of time required for the return on an investment to "repay" the sum of the original investment. For example, a $1000 investment which returned $500 per year would have a two year payback period. The time value of money is not taken into account. Payback period intuitively measures how long something takes to "pay for itself." All else being equal, shorter payback periods are preferable to longer payback periods. Payback period is widely used because of its ease of use despite the recognized limitations described below.

The term is also widely used in other types of investment areas, often with respect to energy efficiency technologies, maintenance, upgrades, or other changes. For example, a compact fluorescent light bulb may be described as having a payback period of a certain number of years or operating hours, assuming certain costs. Here, the return to the investment consists of reduced operating costs. Although primarily a financial term, the concept of a payback period is occasionally extended to other uses, such as energy payback period (the period of time over which the energy savings of a project equal the amount of energy expended since project inception); these other terms may not be standardized or widely used.

Payback period as a tool of analysis is often used because it is easy to apply and easy to understand for most individuals, regardless of academic training or field of endeavour. When used carefully or to compare similar investments, it can be quite useful. As a stand-alone tool to compare an investment to "doing nothing," payback period has no explicit criteria for decision-making (except, perhaps, that the payback period should be less than infinity).

The payback period is considered a method of analysis with serious limitations and qualifications for its use, because it does not account for the time value of money, risk, financing or other important considerations, such as the opportunity cost. Whilst the time value of money can be rectified by applying a weighted average cost of capital discount, it is generally agreed that this tool for investment decisions should not be used in isolation. Alternative measures of "return" preferred by economists are net present value and internal rate of return. An implicit assumption in the use of payback period is that returns to the investment continue after the payback period. Payback period does not specify any required comparison to other investments or even to not making an investment.

Payback period is usually expressed in years. Start by calculating Net Cash Flow for each year: Net Cash Flow Year 1 = Cash Inflow Year 1 - Cash Outflow Year 1. Then Cumulative Cash Flow = (Net Cash Flow Year 1 + Net Cash Flow Year 2 + Net Cash Flow Year 3 ... etc.) Accumulate by year until Cumulative Cash Flow is a positive number: that year is the payback year.

To calculate a more exact payback period: Payback Period = Amount to be Invested/Estimated Annual Net Cash Flow 1

It can also be calculated using the formula:

Payback Period = $(p - n) \div p + ny$

$= 1 + ny - n \div p$ (unit:years)

Where ny= The number of years after the initial investment at which the last negative value of cumulative cash flow occurs.

n= The value of cash flow at which the last negative value of cumulative cash flow occurs. p= The value of cash flow at which the first positive value of cumulative cash flow occurs. This formula can only be used to calculate the soonest payback period; that is, the first period after which the investment has paid for itself. If the cumulative cash flow drops to a negative value some time after it has reached a positive value, thereby changing the payback period, this formula can't be applied. This formula ignores values that arise after the Payback Period has been reached.

Additional complexity arises when the cash flow changes sign several times; i.e., it contains outflows in the midst or at the end of the project lifetime. The modified payback period algorithm may be applied then. First, the sum of all of the cash outflows is calculated. Then the cumulative positive cash flows are determined for each period. The modified payback is calculated as the moment in which the cumulative positive cash flow exceeds the total cash outflow.

Depreciation

In accountancy, **depreciation** refers to two aspects of the same concept:

1. The decrease in value of assets (fair value depreciation), and

2. The allocation of the cost of assets to periods in which the assets are used (depreciation with the matching principle).

The former affects the balance sheet of a business or entity, and the latter affects the net income that they report. Generally the cost is allocated, as depreciation expense, among the periods in which the asset is expected to be used. This expense is recognized by businesses for financial reporting and tax purposes. Methods of computing depreciation, and the periods over which assets are depreciated, may vary between asset types within the same business. These may be specified by law or accounting standards, which may vary by country. There are several standard methods of computing depreciation expense, including fixed percentage, straight line, and declining balance methods. Depreciation expense generally begins when the asset is placed in service. For example, a depreciation expense of 100 per year for 5 years may be recognized for an asset costing 500.

Accounting concept

In determining the profits (net income) from an activity, the receipts from the activity must be reduced by appropriate costs. One such cost is the cost of assets used but not immediately consumed in the activity. Such cost so allocated in a given period is equal to the reduction in the value placed on the asset, which is initially equal to the amount paid for the asset and subsequently may or may not be related to the amount expected to be received upon its disposal. Depreciation is any method of allocating such net cost to those periods in which the organisation is expected to benefit from use of the asset. The asset is referred to as a depreciable asset. Depreciation is technically a method of allocation, not valuation, even though it determines the value placed on the asset in the balance sheet.

Any business or income producing activity using tangible assets may incur costs related to those assets. If an asset is expected to produce a benefit in future periods, some of these costs must be deferred rather than treated as a current expense. The business then records depreciation expense in its financial reporting as the current period's allocation of such costs. This is usually done in a rational and systematic manner. Generally this involves four criteria:

- cost of the asset,
- expected salvage value, also known as residual value of the asset,
- estimated useful life of the asset, and
- a method of apportioning the cost over such life

Depreciable basis

Cost generally is the amount paid for the asset, including all costs related to acquisition.[5] In some countries or for some purposes, salvage value may be ignored. The rules of some countries specify lives and methods to be used for particular types of assets. However, in most countries the life is based on business experience, and the method may be chosen from one of several acceptable methods.

Net basis

When a depreciable asset is sold, the business recognizes gain or loss based on net basis of the asset. This net basis is cost less depreciation.

Impairment

Accounting rules also require that an impairment charge or expense be recognized if the value of assets declines unexpectedly.[6] Such charges are usually nonrecurring, and may relate to any type of asset.

Depletion and amortization

Depletion and amortization are similar concepts for minerals (including oil) and intangible assets, respectively. Depreciation expense does not require current outlay of cash. However since depreciation is an expense to the P&L account, provided the enterprise is operating in a manner that covers its expenses (e.g. operating at a profit) depreciation is a source of cash in a statement of cash flows, which generally offsets the cash cost of acquiring new assets required to continue operations when existing assets reach the end of their useful lives.

Historical cost

Depreciation is generally recognized under historical cost systems of accounting. Some proposals for fair value accounting have no provision for depreciation expense.

Accumulated depreciation

While depreciation expense is recorded on the income statement of a business, its impact is generally recorded in a separate account and disclosed on the balance sheet as accumulated depreciation, under fixed assets, according to most accounting principles. Accumulated depreciation is known as a contra account, because it separately shows a negative amount that is directly associated with another account.

Without an accumulated depreciation account on the balance sheet, depreciation expense is usually charged against the relevant asset directly. The values of the fixed assets stated on the balance sheet will decline, even if the business has not invested in or disposed of any assets. The amounts will roughly approximate fair value. Otherwise, depreciation expense is charged against accumulated depreciation. Showing accumulated depreciation separately on the balance sheet has the effect of preserving the historical cost of assets on the balance sheet. If there have been no investments or dispositions in fixed assets for the year, then the values of the assets will be the same on the balance sheet for the current and prior year. In other words it is a method of recovering capital expenditure in installments which is called as depreciation.

Methods of depreciation

There are several methods for calculating depreciation, generally based on either the passage of time or the level of activity (or use) of the asset.

Straight-line depreciation

Straight-line depreciation is the simplest and most often used method. In this method, the company estimates the salvage value of the asset at the end of the period during which it will be used to generate revenues (useful life). (The salvage value is an estimate of the value of the asset at the time it will be sold or disposed of; it may be zero or even negative. Salvage value is also known as scrap value or residual value.) The company will then charge the same amount to depreciation each year over that period, until the value shown for the asset has reduced from the original cost to the salvage value.

Straight-line method:

$$\text{Annual Depreciation Expense} = \frac{\text{Cost of Fixed Asset} - \text{Residual Value}}{\text{Useful Life of Asset}(years)}$$

For example, a vehicle that depreciates over 5 years is purchased at a cost of \$17,000, and will have a salvage value of \$2000. Then this vehicle will depreciate at \$3,000 per year, i.e. (17-2)/5 = 3. This table illustrates the straight-line method of depreciation. Book value at the beginning of the first year of depreciation is the original cost of the asset. At any time book value equals original cost minus accumulated depreciation.

book value = original cost − accumulated depreciation Book value at the end of year becomes book value at the beginning of next year. The asset is depreciated until the book value equals scrap value.

Book value at beginning of year	Depreciation expense in year	Accumulated depreciation at end of year	Book value at end of year
\$17,000 (original cost)	\$3,000	\$3,000	\$14,000
\$14,000	\$3,000	\$6,000	\$11,000
\$11,000	\$3,000	\$9,000	\$8,000
\$8,000	\$3,000	\$12,000	\$5,000
\$5,000	\$3,000	\$15,000	\$2,000 (scrap value)

If the vehicle were to be sold and the sales price exceeded the depreciated value (net book value) then the excess would be considered a gain and subject to depreciation recapture. In addition, this gain above the depreciated value would be recognized as ordinary income by the tax office. If the sales price is ever less than the book value, the resulting capital loss is tax deductible. If the sale price were ever more than the original book value, then the gain above the original book value is recognized as a capital gain.

If a company chooses to depreciate an asset at a different rate from that used by the tax office then this generates a timing difference in the income statement due to the difference (at a point in time) between the taxation department's and company's view of the profit.

Declining-balance method (or Reducing balance method)

Depreciation methods that provide for a higher depreciation charge in the first year of an asset's life and gradually decreasing charges in subsequent years are called **accelerated depreciation methods**. This may be a more realistic reflection of an asset's actual expected benefit from the use of the asset: many assets are most useful when they are new. One popular accelerated method is the **declining-balance method**. Under this method the book value is reduced by a fixed percentage each year.

Depreciation in year = Depreciation rate * Book Value at start of year The most common depreciation rate used is double the straight-line rate. For this reason, this technique is sometimes referred to as the **double-declining-balance method**. To illustrate, suppose a business has an asset with $1,000 original cost, $100 salvage value, and 5 years of useful life. First, the straight-line depreciation rate would be 1/5, i.e. 20% per year. Under the double-declining-balance method, double that rate, i.e. 40% depreciation rate would be used. The table below illustrates this:

Book value at beginning of year	Depreciation rate	Depreciation expense	Accumulated depreciation	Book value at end of year
$1,000 (original cost)	40%	$400	$400	$600
$600	40%	$240	$640	$360
$360	40%	$144	$784	$216
$216	40%	$86.40	$870.40	$129.60
$129.60	$129.60 - $100	$29.60	$900	$100 (scrap value)

When using the double-declining-balance method, the salvage value is not considered in determining the annual depreciation, but the book value of the asset being depreciated is never brought below its salvage value, regardless of the method used. Depreciation ceases when either the salvage value or the end of the asset's useful life is reached.

Since double-declining-balance depreciation does not always depreciate an asset fully by its end of life, some methods also compute a straight-line depreciation each year, and apply the greater of the two. This has the effect of converting from declining-balance depreciation to straight-line depreciation at a midpoint in the asset's life.

With the declining balance method, one can find the depreciation rate that would allow exactly for full depreciation by the end of the period, using the formula:

$$\text{depreciation rate} = 1 - \sqrt[N]{\frac{\text{residual value}}{\text{cost of fixed asset}}},$$

where N is the estimated life of the asset (for example, in years).

Activity depreciation

Activity depreciation methods are not based on time, but on a level of activity. This could be miles driven for a vehicle, or a cycle count for a machine. When the asset is acquired, its life is estimated in terms of this level of activity. Assume the vehicle above is estimated to go 50,000 miles in its lifetime. The per-mile depreciation rate is calculated as: ($17,000 cost - $2,000 salvage) / 50,000 miles =$0.30 per mile. Each year, the depreciation expense is then calculated by multiplying the number of miles driven by the per-mile depreciation rate.

Sum-of-years-digits method

Sum-of-years-digits is a depreciation method that results in a more accelerated write-off than the straight line method, and typically also more accelerated than the declining balance method. Under this method the annual depreciation is determined by multiplying the depreciable cost by a schedule of fractions.

depreciable cost = original cost − salvage value

book value = original cost − accumulated depreciation

Example: If an asset has original cost of $1000, a useful life of 5 years and a salvage value of $100, compute its depreciation schedule.

First, determine years' digits. Since the asset has useful life of 5 years, the years' digits are: 5, 4, 3, 2, and 1.

Next, calculate the sum of the digits: 5+4+3+2+1=15

The sum of the digits can also be determined by using the formula (n^2+n)/2 where n is equal to the useful life of the asset in years. The example would be shown as (5^2+5)/2=15

Depreciation rates are as follows:

5/15 for the 1st year, 4/15 for the 2nd year, 3/15 for the 3rd year, 2/15 for the 4th year, and 1/15 for the 5th year.

Book value at beginning of year	**Total depreciable cost**	**Depreciation rate**	**Depreciation expense**	**Accumulated depreciation**	**Book value at end of year**
$1,000 (original cost)	$900	5/15	$300 ($900 * 5/15)	$300	$700
$700	$900	4/15	$240 ($900 * 4/15)	$540	$460
$460	$900	3/15	$180 ($900 * 3/15)	$720	$280
$280	$900	2/15	$120 ($900 * 2/15)	$840	$160
$160	$900	1/15	$60 ($900 * 1/15)	**$900**	**$100 (scrap value)**

Units-of-production depreciation method

Under the units-of-production method, useful life of the asset is expressed in terms of the total number of units expected to be produced:

$$\text{Annual Depreciation Expense} = \frac{\text{Cost of Fixed Asset} - \text{Residual value}}{\text{Estimated Total Production}} \times \text{Actual Production}$$

Suppose, an asset has **original cost $70,000**, **salvage value $10,000**, and is expected to produce **6,000 units**.

Depreciation per unit = ($70,000−10,000) / 6,000 = $10

10 × actual production will give the depreciation cost of the current year.

The table below illustrates the **units-of-production** depreciation schedule of the asset.

Book value at beginning of year	Units of production	Depreciation cost per unit	Depreciation expense	Accumulated depreciation	Book value at end of year
$70,000 (original cost)	1,000	$10	$10,000	$10,000	$60,000
$60,000	1,100	$10	$11,000	$21,000	$49,000
$49,000	1,200	$10	$12,000	$33,000	$37,000
$37,000	1,300	$10	$13,000	$46,000	$24,000
$24,000	1,400	$10	$14,000	**$60,000**	**$10,000 (scrap value)**

Depreciation stops when book value is equal to the scrap value of the asset. In the end, the sum of accumulated depreciation and scrap value equals the original cost.

Composite depreciation method

The composite method is applied to a collection of assets that are not similar, and have different service lives. For example, computers and printers are not similar, but both are part of the office equipment. Depreciation on all assets is determined by using the straight-line-depreciation method.

Asset	Historical cost	Salvage value	Depreciable cost	Life	Depreciation per year
Computers	$5,500	$500	$5,000	5	$1,000
Printers	$1,000	$100	$ 900	3	$ 300
Total	$ 6,500	$600	$5,900	4.5	$1,300

Composite life equals the total depreciable cost divided by the total depreciation per year. $5,900 / $1,300 = 4.5 years.

Composite depreciation rate equals depreciation per year divided by total historical cost. $1,300 / $6,500 = 0.20 = 20%

Depreciation expense equals the composite depreciation rate times the balance in the asset account (historical cost). (0.20 * $6,500) $1,300. Debit depreciation expense and credit accumulated depreciation.

When an asset is sold, debit cash for the amount received and credit the asset account for its original cost. Debit the difference between the two to accumulated depreciation. Under the composite method no gain or loss is recognized on the sale of an asset. Theoretically, this makes sense because the gains and losses from assets sold before and after the composite life will average themselves out.

To calculate composite depreciation rate, divide depreciation per year by total historical cost. To calculate depreciation expense, multiply the result by the same total historical cost. The result, not surprisingly, will equal to the total depreciation Per Year again.

Common sense requires depreciation expense to be equal to total depreciation per year, without first dividing and then multiplying total depreciation per year by the same number.

Tax depreciation

Most income tax systems allow a tax deduction for recovery of the cost of assets used in a business or for the production of income. Such deductions are allowed for individuals and companies. Where the assets are consumed currently, the cost may be deducted currently as an expense or treated as part of cost of goods sold. The cost of assets not currently consumed generally must be deferred and recovered over time, such as through depreciation. Some systems permit full deduction of the cost, at least in part, in the year the assets are acquired. Other systems allow depreciation expense over some life using some depreciation method or percentage. Rules vary highly by country, and may vary within a country based on type of asset or type of taxpayer. Many systems that specify depreciation lives and methods for financial reporting require the same lives and methods be used for tax purposes. Most tax systems provide different rules for real property (buildings, etc.) and personal property (equipment, etc.).

Capital allowances

A common system is to allow a fixed percentage of the cost of depreciable assets to be deducted each year. This is often referred to as a capital allowance, as it is called in the United Kingdom. Deductions are permitted to individuals and businesses based on assets placed in service during or before the assessment year. Canada's Capital Cost Allowance are fixed percentages of assets within a class or type of asset. Fixed percentage rates are specified by type of asset. The fixed percentage is multiplied by the tax basis of assets in service to determine the capital allowance deduction. The tax law or regulations of the country specifies these percentages. Capital allowance calculations may be based on the total set of assets, on sets or pools by year (vintage pools) or pools by classes of assets.

Tax lives and methods

Some systems specify lives based on classes of property defined by the tax authority. Canada

Revenue Agency specifies numerous classes based on the type of property and how it is used. Under the United States depreciation system, the Internal Revenue Service publishes a detailed guide which includes a table of asset lives and the applicable conventions. The table also incorporates specified lives for certain commonly used assets (e.g., office furniture, computers, automobiles) which override the business use lives. U.S. tax depreciation is computed under the double declining balance method switching to straight line or the straight line method, at the option of the taxpayer. IRS tables specify percentages to apply to the basis of an asset for each year in which it is in service. Depreciation first becomes deductible when an asset is placed in service.