1. Learning Outcomes

After studying this module, you shall be able to know

- What does the term ‘Drugs’ actually mean?
- How we can classify different drugs?
- What are therapeutic and psychoactive drugs?
- How can we make forensic analysis of different drugs?
2. Introduction : Drug

**DRUG According to “WHO“** can be defined as “A Drug is any substance that is used or proposed to be used to modify or explore physiological structures or pathological states for the benefit of the recipient.”

Eg: paracetamol, ciprofloxacin, sal-butamol, or it can be said that

A **drug** is a stuff which may have medicinal, intoxicating, performance augmenting or other effects, when taken or inserted into a human / animal body and which is not considered a food or a food supplement.

Drugs are defined differently by various drug control laws, government regulations, as medicine or on the basis of their usage.

The definition of drug in pharmacology, can be stated as “a chemical substance used in the treatment, cure, prevention or diagnosis of disease or otherwise used to enhance physical or mental well-being”. For chronic disorders, Drugs can be prescribed for a limited duration or on a regular basis.

Drugs of Hallucinogens and Opioids are the examples of Recreational drugs, which are chemical substances that affect the CNS. These type of drugs are abused for distinguished beneficial effects on consciousness, perception, behavior and personality. Addiction and habituation is the beginning drugs abuse.

Drugs which are taken from outside the organism this usually distinguished from endogenous biochemical. For example, when hormone insulin is synthesized in the body; it is called a hormone when it is synthesized by the pancreas inside the body, but it is called a drug when it is introduced into the body from outside.
3. Classification of Drugs

On the basis of the purpose of their use, different drugs can be classified into following two heads:

- Therapeutic Drugs
- Psychoactive Drugs

Although both of these categories often overlap. Due to the specific usage and wide range, psychoactive drugs are treated as a distinct class.

3.1 Therapeutic Drugs

A Therapeutic drug is a substance that has healing or preventive properties in relation to certain diseases, or is administered to enable a medical diagnosis.

The drugs in common therapeutic use that may be classified chiefly into following four categories:

1) Analgesics and Antipyretics. An analgesic is a type of drug that relieves pain. On the other part, an antipyretic is a type of drug that is used to reduce the temperature of the body. Aspirin and Paracetamol are the commonly used drugs in this category.

Aspirin (Acetylsalicylic Acid) is a white crystalline powder having an acidic taste and is used commonly in houses for pains, aches, etc. Even small doses of this drug may prove to be fatal due to idiosyncrasy. However, minimum fatal dose is about 5-10 grams.

Paracetamol (Acetaminophen) is a metabolite of phenacetin, and is widely in use these days in place aspirin. Ingestion of 20 tablets of 500 milligram each within three to five days is proved to be fatal.

2) Antihistaminics. These are the drugs which antagonize the action of histamine. These are commonly used in allergic disorders and other conditions like common cold. The common preparations include: Promethazine hydrochloride (Phenergan), Diphenhydramine (Benadryl), Chlorcyclizine (Histantin), Antazoline (Antistine), etc. Its fatal dose is about one gram.

3) Antidepressants. These are the drugs which are generally used in psychiatric disorders to treat the endogenous depression. These drugs have an initial sedative effect which is followed by an antidepressant effect within a week or more.

Commonly used antidepressant drugs are: Imipramine, Amitriptyline, etc.
4) **Tranquilizers.** These are the drugs that produce a general tranquility without the impairment of high-thinking facilities or the inducement of a sleep. To reduce tension and anxiety of mental patients, Tranquilizers like reserpine and chlorpromazine are useful.

3.2 **Psychoactive Drugs**

A psychoactive drug, psycho-pharmaceutical or psychotropic drug is a chemical substance that acts principally upon the central nervous system where it affects brain function, resulting in modification in perception, mood, consciousness, cognition, and behavior. These substances may be used recreationally, to purposefully change one's consciousness, or for ritual, spiritual, or shamanic purposes. e.g., like anesthetics, analgesics or for the treatment of psychiatric disorders, these types of psychoactive drugs also have therapeutic activity.

Psychoactive drugs bring about marked changes in consciousness and mood that the user may find pleasant (e.g. euphoria) or advantageous (e.g. increased state of mind) and are thus reinforcing. Despite health risks and neglecting consequences, many psychoactive substances are misused/abused, that is, used excessively, with continuous use of some substances, psychological and physical dependence ("addiction") may develop.

Worldwide, many governments posed restrictions on drug production and sales in an attempt to decrease drug abuse, due to misuse and physical dependency on drugs.

3.2.1 **Classification**

Psychoactive substances are used by human beings for varied reasons. Social sleep aids and social drinking are some of the examples. World’s largest consumption of psychoactive substance is caffeine, but unlike other drugs, it is unregulated and legal in almost all jurisdictions.

According to pharmacological effects in the body, psychoactive drugs are divided into different categories.

Generally used psychoactive drugs are:-

**Narcotics, stimulants, Hallucinogens, Depressants and Anabolic steroids.**
Let’s Discuss it one by one:-

1) **Narcotics.** The term is originated from Greek word *narkotikos* that means a state of lethargy. This group comprises of substances that act on the CNS and bring relief from discomfort and produce sleep. The origin of most narcotics is opium, a sticky milky juice obtained from the unripe pod of poppy (*Papaver somniferum*).

Example: Opium, morphine, heroin, codeine, synthetic opiates, etc.

**Morphine** is obtained from raw opium. It is normally administered by injection by hypodermic needle. It results in a euphoric state, with sleepy and relaxed appearance of the user. It is generally 3 to 5 times stronger than opium.

**Heroin** (diacetylmorphine) is a white crystalline powder, which is derivative by adding two acetyl groups to the morphine, found in the opium. Heroin in impure form is known as Brown Sugar. It is 10-15 times more effective than morphine. It may be either injected or sniffed to cause similar effects as that of opium and heroin but with higher magnitude.

**Codeine** is also a byproduct of morphine but is less effective as analgesic. It acts as a base in many pain relievers and cough remedies.

**Signs and symptoms of Narcotic abuse**

- Respiratory depression (shallow breathing),
- Small pupils, bloodshot eyes
- Nausea, vomiting
- Itching skin, flushed skin
- Constipation
- Poor judgment
- Confusion

2) **Stimulants** (“uppers”). Stimulants consist of substances that, stimulates the mind, wakes one up and euphoria (a feeling of well-being), but do not affect perception. These drugs are also referred in the terminology of “speed”.

Examples: Amphetamines, methamphetamine, caffeine, nicotine, cocaine, etc.
Amphetamine or its derivative methamphetamine may be injected direct into the blood stream through intravenous injection. The desire for a more intense experience is the chief motive behind this route of administration. First sensation of "flash" or "rush" initiates, followed by high feeling of pleasure, euphoria that produces hyperactivity, with a feeling of clarity of vision as well as hallucinations. After the effect wears off, the individual passes through a period of exhaustion and may sleep continuously for one to two days.

Another type of amphetamine is methamphetamine called "speed" because of its rapid stimulation of central nervous system.

Cocaine is also a potent stimulant that produces similar effects as that of amphetamines—namely, increased alertness, accompanied by suppression of hunger and fatigue. It is generally sniffed and is absorbed into the body by the mucous membrane of the nose.

One other form of cocaine which is quite popular is “crack”. It is manufactured by heating the mixture of cocaine, baking soda and water. It is also snorted and produces similar effects like cocaine.

3) **Hallucinogens**, including psychedelics, dissociatives and deliriants. This category comprises all those substances that produce distinct alterations in normal thought processes, perceptions and mood. There are a number of substances with varying chemical compositions that have hallucinogenic properties.

Examples: LSD (lysergic acid diethylamide), PCP (phencyclidine), DMT (dimethyltryptamine), mescaline, psilocybin, etc.

LSD is synthesized from lysergic acid, a substance derived from ergot, which is a type of fungus that attacks certain type of grains. This is a very potent drug, only 25 mg is sufficient to start clear visual hallucinations in the mind that may last for about 12 hours. This drug produces noticeable changes in mood, leading to laughing and crying at the slightest provocation. Feeling of anxiety and tension always accompanied LSD use.

On the other hand, PCP is synthesized by quite a simple chemical process, thus is much more easily available. PCP is frequently mixed with other drugs like amphetamine or LSD, and is sold as a Powder ("Angel Dust"), capsules or tablets, or as a liquid. The drug is smoked, ingested or sniffed.

Marijuana is an example of a psychoactive drug that combines properties of each of these groups.

Cannabis plant (charas, bhaang, ganja & hashish)

4) **Depressants** ("downers"), including sedatives, hypnotics, and narcotics. This category consist of all of the sleep inducing, calmative, anxiety-reducing, anesthetizing substances, which induces perceptual changes like dream sequences, and also often bring to the mind the feelings of euphoria.

Examples: Alcoholic beverages (ethanol), barbiturates, benzodiazepines, etc.
Like alcohol, **barbiturates** act on central nervous system to suppress its vital functions so relax, create a feeling of well being and produces sleep. Barbiturates are usually administered by mouth. The average sedative dose is about 10-70 milligrams. There are about 25 barbiturate derivatives.

Some barbiturates are absorbed more slowly than others and are generally termed as “**Long acting barbiturates**” like Phenobarbital. On the other part, some barbiturates are absorbed rather quickly and are termed as “**Short acting barbiturates**” like Pentobarbital, Secobarbital, etc. Apparently, abusers prefer the faster acting ones.

4. **Risks Associated with Drugs**

Drug use can never be 100% safe. Different drugs have different dangers associated with them. Drugs like alcohol, heroin and tranquillizers have a sedative effect; that slows down the process of the body and brain functions. Using sedatives may also lead to physical dependency and withdrawal symptoms, on the other part drugs like cannabis don’t have physical dependence.

If stimulants are abused in huge quantities, it can bring anxiety or panic attacks. People who have heart and blood pressure problems, stimulants are particularly harmful for them.

Similarly, hallucinogens sometimes produce very disturbing experiences and leads to erratic or dangerous behaviour by the abuser, especially if they are already unstable.

4. **Forensic Analysis of Drugs**

In order to meet the legal requirements, the forensic analysis of such drugs proceeds from screening tests to more specific confirmatory tests. Suppose a white “Powdered Sugar” is obtained from the crime scene, the primary task would be to confirm the identity of the substance.

Most confirmatory analyses employed for drug identification are moderately time-consuming and require the use of many sophisticated and expensive instrumentation such as a gas chromatograph-mass spectrometer or a Fourier transform infrared spectrophotometer. To save time and money, before conducting a confirmatory analysis (potentially resulting in conclusive information), quick and inexpensive presumptive drug analyses should be done. These analyses not only direct the forensic scientist toward an appropriate confirmatory analysis that will yield the desired results but also saves time.
Following are the screening and confirmatory tests which are normally performed:

5.1 Color Tests/Spot Tests

Many drugs yield characteristic colors when they are allowed to react with certain specific chemical reagents. These tests not only indicate the presence of certain drug but also are for screening purposes to give the investigator a proper direction in which he can proceed his investigation.

Color tests, sometimes called spot tests, are examples of presumptive drug tests used to probe questioned drug samples for their chemical properties. If chemical properties consistent with a known drug are discovered, a questioned drug sample can be presumptively identified. When conducting a color test, chemicals known to produce a colored product in the presence of a suspected drug are added to a small amount of the questioned sample. If the questioned sample contains the suspected drug, a colored product, having a color representative of the suspected drug, will be produced. For example, cocaine produces a blue product when allowed to react with the chemical cobalt thiocyanate and LSD produces a red-violet product when allowed to react with p-dimethylaminobenzaldehyde.

Many substances other than drugs will react with the chemicals used for presumptive drug identification and produce products of varying colors, or no color at all. The differing color (or no color) suggests that the questioned sample does not contain the suspected drug. Yet, many other substances will produce a product with the same representative color as the suspected drug. For example, in the presence of cobalt thiocyanate, lidocaine, benzocaine and procaine all yield a blue-colored product similar to that of cocaine.

For this reason, a positive color test is not confirmatory and simply directs the forensic scientist toward identification by limiting the possible number of drugs. For example, if a blue product is formed with cobalt thiocyanate, methamphetamine, heroin, and LSD can be excluded as possible identities of the unknown substance. Color test reactions are generally performed in crime laboratories using spot plates.

Spot plates are small ceramic or plastic dishes that contain several wells. Because most drug color tests are quite sensitive, requiring few micrograms of the sample being tested, the small wells of a spot plate are ideal for analysis. In addition, neighboring wells can be used to conduct Positive (drug standard) and negative (no drug) controls. Side-by-side comparison of colors generated from the questioned sample and the control samples assist in positive identification.

Typically, different chemicals are used for each drug to be tested. Some chemicals, however, are used for more than one class of drugs. For example, the Marquis test, consisting of two chemicals (Concentrated sulphuric acid and formaldehyde) yields a purple product for opiates like morphine, heroin, codeine, and oxycodone and an orange-red product for amphetamine and methamphetamine.
Following is a table of a few reagents which are generally used in drug screening-

<table>
<thead>
<tr>
<th>TESTS RESULTS</th>
<th>CHEMICALS</th>
<th>POSITIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Van Urk LSD: purple</td>
<td>P-dimethylaminobenzaldehyde in 10% concentrated HCl and ethanol</td>
<td></td>
</tr>
<tr>
<td>2. Marquis brown orange derivatives: purple</td>
<td>2% formaldehyde in sulphuric acid</td>
<td>Amphetamine</td>
</tr>
<tr>
<td>3. Simon's Methamphetamine: deep blue</td>
<td>sodium nitroprusside and Na₂CO₃</td>
<td>Opium</td>
</tr>
<tr>
<td>4. Dillie-koppanyi Barbiturates: violet</td>
<td>1% cobalt acetate in CH₃OH followed by 5% isopropylamine in CH₃OH</td>
<td></td>
</tr>
<tr>
<td>5. Scott derivatives: blue</td>
<td>cobalt thiocyanate, HCl, glycerine and chloroform</td>
<td>Cocaine</td>
</tr>
</tbody>
</table>

5.2 Microcrystal Tests

Microcrystal tests are more specific than color tests. In these tests, different reagents are made to react the drug, producing a crystalline precipitate. It is the size and shape of the crystal, under microscopic examination, which are highly characteristic of drug. However, these tests are also not confirmatory, so the presence of a certain drug needs to be further confirmed by various sophisticated instruments.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>REAGENTS</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heroin</td>
<td>Platinum chloride</td>
<td>Rosette</td>
</tr>
<tr>
<td>Morphine</td>
<td>Potassium chromate</td>
<td>Small platelets</td>
</tr>
<tr>
<td>Nicotine</td>
<td>Sodium carbonate</td>
<td>Rosette and bunches of needles</td>
</tr>
<tr>
<td>Papaverine</td>
<td>Platinum chloride</td>
<td>Yellow plates</td>
</tr>
<tr>
<td>Thebaine</td>
<td>Platinum chloride</td>
<td>Dense Rosettes</td>
</tr>
</tbody>
</table>
5.3 Confirmatory Tests

There are a number of tests which can detect the presence of drugs even when they are present in a very minute quantity. For the quantitative and qualitative analysis of drugs, various chromatographic techniques are used which are excellent methods. Thin layer chromatography (TLC), gas chromatography (GC) and high performance liquid chromatography (HPLC), etc. are some of the examples which are used for confirmatory tests.

Confirmatory tests require high selectivity and sensitivity towards drugs, as well as their metabolites, and is frequently carried out by GC/MS. Gas chromatography technique is grounded on the parting of unstable (Volatile) samples by their exceptional affinity for the column. Target drug compounds in the sample are recognized by their holding time when samples are made to run through the chromatographic columns.

Gas Chromatography combined with mass spectrometry is a robust method because structures of anonymous compounds can be recognized after they have been separated using GC method. HPLC, FTIR, and UV/Vis are other analytical instruments, found in forensic laboratories as corresponding techniques.

5. Summary

- A drug is a substance which may have medicinal, intoxicating, performance augmenting or other effects, when taken or put into a human body or the body of another animal and is not considered a food.
- Different drugs can be categorized into therapeutic drugs and psychoactive drugs.
- A psychoactive drug, psycho-pharmaceutical or psychotropic is a chemical substance that acts primarily upon the central nervous system where it affects brain function, resulting alterations in perception, mood, consciousness, cognition and behavior.
- The therapeutic drugs may be categorized chiefly into four categories: analgesics and antipyretics, antihistamines, antidepressants and tranquilizers.
- Psychoactive drugs are categorised into different groups: narcotics, stimulants, depressant and hallucinogens.
- Drug use can never be 100% safe. Different drugs have different dangers associated with them.
- The forensic analysis of such drugs proceeds from screening tests to more specific confirmatory tests.
- Screening tests includes Colour/spot tests and microcrystal tests which are further confirmed by different sophisticated instruments.