# UNIT 3: VENN DIAGRAMMATIC TECHNIQUE FOR TESTING THE CATEGORICAL SYLLOGISM

## UNIT STRUCTURE


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## 3.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define standard form of categorical syllogism
- explain the structure of categorical syllogism
- discuss the rules of categorical syllogism
- define figure and mood of syllogism
- describe what Venn diagram is.

## 3.2 INTRODUCTION

This unit introduces to you syllogistic reasoning. Arguments are of two types– Deductive and Inductive. In deductive argument conclusion necessarily follows from the premises. That is, in deductive argument the premises provide conclusive support for accepting the conclusion. Aristotelian

deductive logic is primarily concerned with syllogistic reasoning. In the general sense of the term, a syllogism is a deductive argument consisting of two premises and one conclusion. This unit includes the definition as well as the structure of the categorical syllogism. A categorical syllogism is a deductive argument which contains two premises and one conclusion and conclusion necessarily follows from the two premises taken jointly. A standard form of categorical syllogism consists of three standard form categorical propositions and three terms which are arranged in a specified standard order. Apart from these, you will able to conceive the meaning of figure and mood of syllogism and Venn diagram technique for testing syllogism.

## 3.3 SYLLOGISM

Logic is generally described as a science of reasoning. Inferences or reasonings are of two types. They are Deductive and Inductive. In a deductive inference, the conclusion can never be more general than its premise or premises. That is, the conclusion is contained or implied in the premises. On the other hand, in an inductive inference, the conclusion is always more general than the premises. That is, the conclusion goes beyond the premises.

Deductive inference is of two types-mediate deductive inference and immediate deductive inference. **A syllogism is a form of mediate deductive inference, in which the conclusion necessarily follows from two premises, taken jointly.** From this definition we can grasp the nature and structure of syllogism.

**Firstly**, a syllogism is a mediate deductive inference. As a kind of inference, its conclusion expresses something other than those which are expressed in the premises. Further, as it is *deductive* in character, its conclusion can never be more general than either of its two premises, rather the conclusion contained in the premises. It is a *mediate* form of inference, the conclusion being drawn from more than one premise.

**Secondly,** the two premises of a syllogism are logically interconnected and thus the conclusion necessarily follows from the two premises taken jointly.

**Thirdly**, since the conclusion follows necessarily from the premises, so the conclusion of a syllogistic argument becomes formally true or valid.

**Fourthly**, a syllogism is purely formal. It is concerned with the formal truth, but not with material truth. That is, in a syllogism, we are not concerned with the question as to whether the given propositions are as a matter of fact, true or false. The only question is, granting the premises to be true, the conclusion must necessarily be true.

## 3.4 KINDS OF SYLLOGISM

Syllogisms have been classified into **Pure** and **Mixed**. In a pure syllogism, all the constituent propositions are of the same relation. If all of them are categorical proposition, the syllogism is known as Pure Categorical; if all the constituent propositions are hypothetical, the syllogism is Pure Hypothetical; and lastly, if all of them are disjunctive, the syllogism is Pure Disjunctive.

In a Mixed Syllogism, on the other hand, the constituent propositions are of different relations. Mixed syllogisms are of three kinds. They are: Hypothetical –Categorical, Disjunctive Categorical and Dilemma.

This unit will focus on categorical syllogism and Venn diagram technique for testing categorical syllogism.

## 3.5 STANDARD FORM CATEGORICAL SYLLOGISM

**A Categorical Syllogism** is one where all its premises and conclusion are categorical propositions. As such, all the constituent propositions of a categorical syllogism are categorical propositions. According to Copi & Cohen, a *categorical syllogism is a deductive argument consisting of three categorical propositions that together contain exactly three terms, each of which occurs in exactly two of the constituent propositions.*

In the preceding section we have explained about categorical propositions and the Venn diagram technique to diagram the standard form categorical propositions. This unit introduces to you the Venn diagram technique for testing categorical syllogism.

**A Standard-Form of Categorical Syllogism** is a categorical syllogism in which the premises and conclusion are all standard –form categorical propositions i.e. either of A, E, I, or O and are arranged in specified standard order. In other words, a standard form categorical syllogism is a form of mediate deductive inference, consisting of three standard form categorical propositions, having between them three and only three terms which are interconnected in such a way that the first two propositions jointly imply the third proposition.

For example, All men are mortal.
All kings are men.
Therefore, all kings are mortal.

## 3.6 STRUCTURE OF STANDARD FORM CATEGORICAL SYLLOGISM

A standard form categorical syllogism consists of two premises and one conclusion. Its premises and conclusion are all standard form categorical propositions. Each proposition consists of two terms. A standard form categorical syllogism has a definite structure that can be explained in the following way.

- Firstly, it is composed of only three standard form categorical propositions.
- Secondly, it contains exactly three terms, each of which occurs twice in the constituent propositions.
- Each term is used in the same sense throughout the argument.
- The major premise is listed first, the minor premise second and the conclusion last.

**Major, Minor and Middle Terms:** A syllogism consists of three terms. They are: major term, minor term and middle term. The term that occurs as the predicate of the conclusion is called the **major term** of the syllogism, and the term that occurs as the subject term of the conclusion is called the **minor term** of the syllogism. The term that occurs in both the premises but not in the conclusion is called the **middle term**. The major and minor terms are called **Extremes**, to distinguish them from the middle term.

The premises of a standard-form syllogism are named after the terms that appear in them. The premise in which the major term occurs with the middle term is called the **major premise**. The premise in which the minor term occurs with the middle term is called the **minor premise**. For example, in the following syllogism–

All men are mortal.

All poets are men.

Therefore, all poets are mortal.

In this syllogism 'mortal' is the major term, being the predicate of the conclusion. The term 'poets' is minor term, because it is the subject of the conclusion; the term 'men' is the middle term, because it occurs in both the premises, but is absent from the conclusion. Further, the first premise-'All men are mortal' is the major premise, because the major term 'mortal' occurs in it. The second premises 'All poets are men' is the minor premise, because the minor term 'poets' occurs in it.

The symbol '**P'** stands for major term '**S'** stands for minor term and '**M'** stands for middle term.



## CHECK YOUR PROGRESS

**Q.1:** What is standard form categorical syllogism?

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**Q.2:** Explain briefly the structure of categorical syllogism.

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**Q.3:** Define:

a) Middle term

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b) Major term

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c) Minor premise

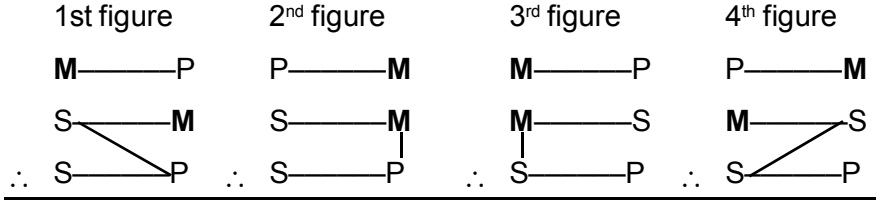
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## 3.7 FIGURE OF SYLLOGISM

As we know that in a syllogism the middle term occurs in both the premises. But the position of middle term is not the same in all syllogisms. Depending on the position of the middle term in both the premises we have different forms of syllogism what is known as figure of syllogism. Figure indicates the position of the middle term in the syllogism. Thus, figure is the form of a syllogism as determined by the position of the middle term in the premises. There are four possible arrangements of the middle term in the two premises and therefore, there are four figures of syllogism viz. first figure, second figure, third figure and fourth figure.

In the first figure the position of the middle term is the subject in the major premise and the predicate in the minor premise. In the second figure the position of the middle term is the predicate in the major premise and subject in the minor premises. The four figures schematized in the following ways–



## 3.8 MOOD OF SYLLOGISM

The mood of a standard form categorical syllogism is determined by the quality and quantity of the constituent standard form categorical propositions. For example, since the following syllogism contains all 'A' propositions (both premises and the conclusion), therefore the mood of the syllogism is AAA.

A– All men are mortal.

A– All poets are men.

A– Therefore all poets are mortal.

Thus the mood of every syllogism is represented by three vowels stand for major premises, minor premises and the conclusion. According to the quality and quantity combined there are four kinds of propositions-A, E, I and O. A syllogism has got two premises. If we take into account the quality and quantity of the premises only, we have 16 possible moods in each figure and 64 (16 X 4)possible moods in all the figures. Again, if we take into account the quality and quantity of all the three constituent propositions, we have 64 possible moods in each figure and 256 (64 X 4) possible moods in all the figures. Out of these 256 moods some are valid and some are invalid. In Aristotelian logic 19 moods are considered to be valid. But under the Boolean interpretation, if we apply Venn diagram for testing the validity or invalidity of these possible moods we get only 15 valid standard form categorical syllogisms.

The valid moods of first figure are: **AAA (BARBARA), AII (DARII), EAE (CELARENT),** and **EIO (FERIO)**

The valid moods of the second figure are: **EAE (CESARE) AEE (CAMESSTRES), EIO (FESTINO),** and **AOO (BAROCO)**

The valid moods of the third figure are: **AAI (DARAPTI), IAI (DISAMIS), AII (DATISI), EAO (FELAPTON) OAO (BOCARDO)** and **EIO (FERISON).**

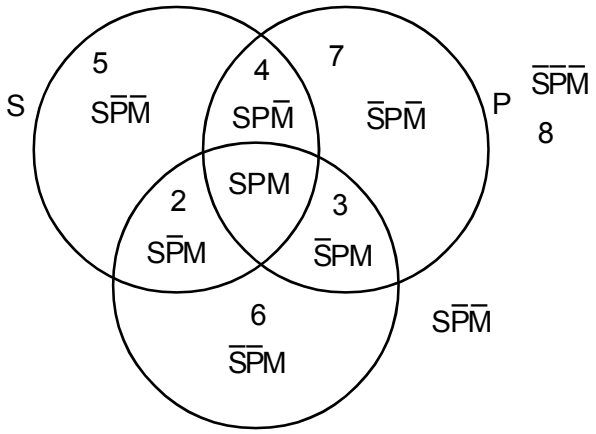
The valid moods of the fourth figure are: **AAI (BRAMANTIP), AEE (CAMENES) IAI (DIMARIS), EAO (FESAPO)** and **EIO (FRESISON).** But the four Aristotelian valid moods, namely, DARAPTI, FELAPTON, BRAMANTIP and FESAPO are invalid moods under Boolean system.

## 3.9 VENN DIAGRAM TECHNIQUE FOR TESTING SYLLOGISM

In the preceding chapter we have discussed how to draw Venn diagram to represent standard form categorical propositions. Now let us apply the Venn diagram technique for testing the standard form categorical syllogism. Venn diagram technique requires the following strategy.

- Since, categorical syllogisms have three terms we have to draw three overlapping circles.
- We have to label the circles by the letters S, P, and M representing the minor term, major term and middle term respectively.
- We first draw the two overlapping circles i.e. circle 'S' and circle 'P' and then we draw the third circle 'M' overlapping the first two circles as shown in the diagram below. The three overlapping circles give the diagram of eight classes or areas. The areas are– $S\bar{P}\bar{M}$, $SP\bar{M}$, $\bar{S}P\bar{M}$, $S\bar{P}M$, $SPM$, $\bar{S}PM$, $\bar{S}\bar{P}M$, $\bar{S}\bar{P}\bar{M}$.
- If the syllogism contains both universal and particular premises, it is necessary to draw the universal premise first irrespective of their given order.
- Finally, to decide whether the argument is valid or not, we see the conclusion whether it is covered by the premises or not.

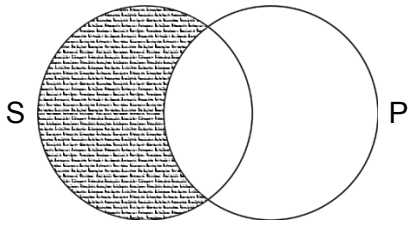
The following diagram can be interpreted in terms of various classes or areas. For example, we can take the letter 'S' for the class of all 'scientists', the letter 'P' for the class of all 'philosophers' and the letter 'M' for the class of all 'writer'. Thus the areas are:



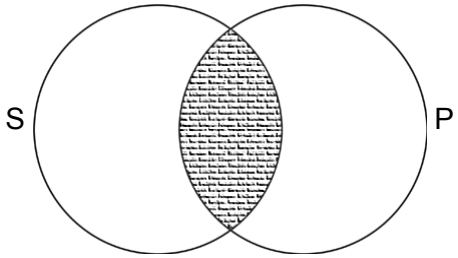
1) SPM– the class of all those people who are scientists and at the same time philosophers and writers.
2) Scientists and $S\bar{P}M$– the class which is the product of scientists and writers and the complement of philosophers.
3) $\bar{S}PM$– is the product of all people who are both philosopher and writer but not scientists.
4) $SP\bar{M}$– is the product of the class scientists and philosophers and not writers.
5) $S\bar{P}\bar{M}$ – is the class of all scientists who are neither philosophers nor writers.
6) $\bar{S}P\bar{M}$ – is the class of all those who are non-scientists, non-philosophers but writers.
7) $\bar{S}P\bar{M}$– the class of philosophers who are not scientists and not writers.
8) $\bar{S}\bar{P}\bar{M}$ – is the product of the class non-scientists, non philosophers and non writers.

By shading out or by inserting an 'X' we can diagram any standard form categorical proposition. The diagrams to represent the A, E, I and 0 propositions have already been shown in the proceeding chapter. Thus, to diagram the proposition 'All S are P' ($S\bar{P} = 0$) proposition we have to shade out all S that is not contained in P as shown below.

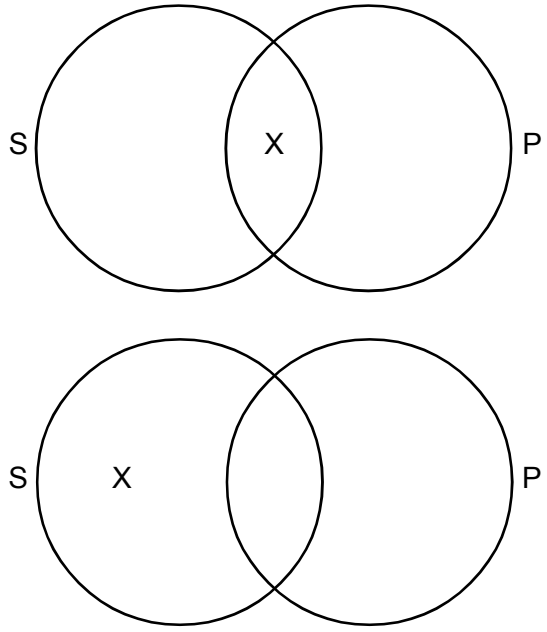
To diagram the proposition 'No S are P' (SP = O) we have to shade out the overlapping part of the circle S and P as shown below.




To diagram the proposition 'Some S are P' ($SP \neq O$) we have to put an X in the overlapping part of the circle S and P.



To diagram the proposition 'Some S are not P' (SP ≠ O) we have to put an X in the part of the circle S that is not contained in P.




Now let us apply the Venn diagram technique to test the validity of the following syllogism.

**Example 1:**

A– All writers are philosophers.

M P

A– All scientists are writers.

S M

Therefore all scientists are philosophers.

S P

This syllogism consists of all A propositions. We symbolise the syllogism in the following way by means of set notation or from the Boolean standpoints.

Major premise– $M \cap \sim P = \Lambda$ or $M\bar{P} = O$

Minor premise– $S \cap \sim M = \Lambda$ or $S\bar{M} = O$

Conclusion– $S \cap \sim P = \Lambda$ or $S\bar{P} = O$

Now let us apply the Venn diagram technique for testing the validity of the argument. We draw the following figures.

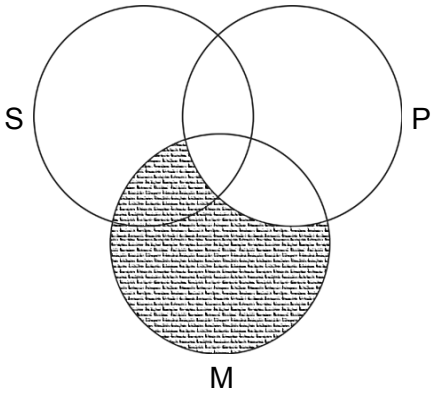



Figure I

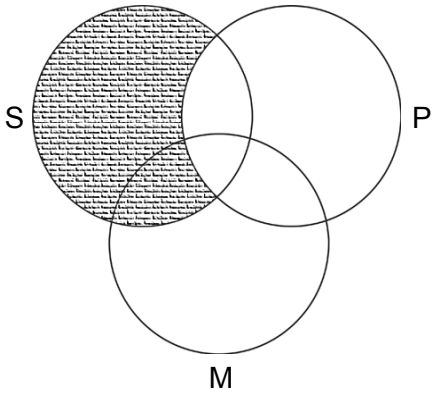



Figure II

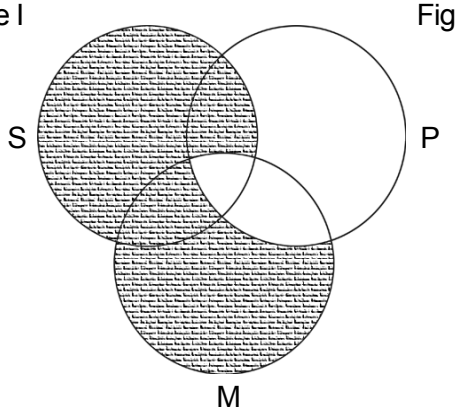



Figure III

Figure I the represents the diagram of the major premise $M\bar{P}$ = O. In this figure the area of the circle M which is not contained in P is horizontally shaded out to diagram the major premise $M\bar{P}$ = O. Likewise, the figure II represents the diagram of the minor premise $S\bar{M}$ = O. In this figure the area of the circle S which is outside M is horizontally shaded out to diagram the minor premise $S\bar{M}$ = O. Now we have to see whether the conclusion is entailed by the premises or not. We have seen that the S that is outside the P is shaded out by the premises. It means, conclusion ($S\bar{P}$ = O) is entailed by the premises and hence the argument is valid.

Now let us take another example of syllogistic reasoning.

**Example 2:**

All men are honest

Some men are scientists

$\therefore$ Some scientists are honest.

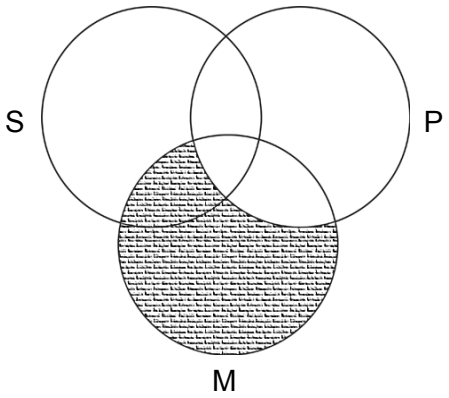
First we symbolise the argument in the following way by means of set notation.

$M\bar{P} = O$

$MS \neq O$

$\therefore\ SP \neq O$

Now we diagram these two premises by drawing three overlapping circles in the following way as shown in the figure below–




We diagram the major premise $M\bar{P} = O$ by shading the area which are in M but not in P that is $SM\bar{P}$ and $S\bar{P}\bar{M}$. The minor premise $MS \neq O$, being an I proposition, we have to put an X in the overlapping part of the circle S and M. The conclusion $SP \neq O$ demands that the overlapping part of the circle S and P must be inserted with an X. In the above diagram we have seen that there is an X in the overlapping part i.e. in the common part of the circle S and P. That means the conclusion is entailed by the premises and therefore the given syllogism is considered to be valid.

**Example 3:**

All poets are creative

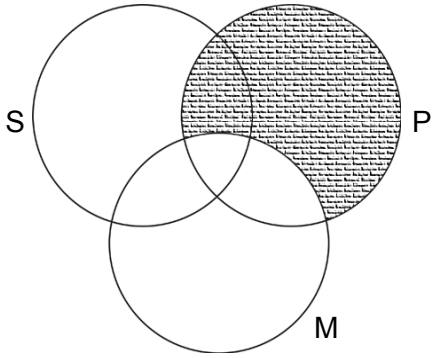
Some men are creative

$\therefore$ Some men are poets

This argument has three propositions, one of which is particular proposition. It is important to note that if one of the premises is a particular proposition then we have to insert an x in the appropriate areas depending on the nature of the proposition. Now let us symbolise the propositions of the argument.

| | | |
|---|---|---|
| Major premise: | A proposition– | $P\bar{M} = 0$ |
| Minor Premise: | I proposition– | $SM \neq 0$ |
| Conclusion: | I proposition– | $SP \neq 0$ |

Let us represent the syllogism diagrammatically–




In the diagram the major premise $P\bar{M} = 0$, which is a universal proposition, is drawn first. To diagram this proposition we have to shade out the portion $SP\bar{M}$ and $\bar{S}P\bar{M}$. The minor premise is an I proposition and to put the x in the any of the region of $S\bar{P}M$ and SPM is puzzling. So x must be put somewhere in the overlapping part of the circles labelled. But the x cannot be put in both the areas because then it would go beyond what the premises assert. So we have to put the x on the line between these two areas. The conclusion $SP \neq 0$ indicates that the inserting area is not empty. But the x on the line does not show it. As such the argument is invalid.

**Example 4:**

No politicians are happy.

All happy people are honest

$\therefore$ Some honest people are not politician.

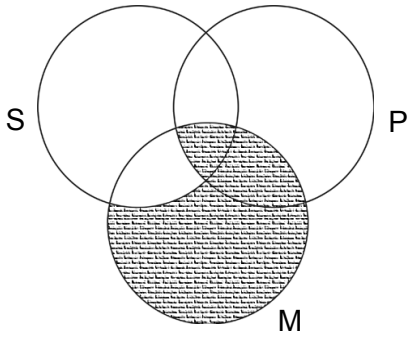
The symbolic expression of the syllogism is the following.

Major premise: E proposition– $PM = 0$

Minor premise: A proposition– $M\bar{S} = 0$

Conclusion: 0 proposition– $S\bar{P} \neq 0$

Let us represent the syllogism diagrammatically–



The above diagram clearly shows that there is no x in any of the areas in the projected conclusion. As the premises are universal propositions, so there is no necessity of inserting any x anywhere in the diagram. As such the argument is invalid and it commits the *existential fallacy*. Because, here both the premises are universal propositions but the conclusion is a particular proposition.

**Example 5:**

No players are philosophers.

Some scientists are not philosophers.

$\therefore$ Some scientists are not players.

Major premise: E proposition– $MP = 0$

Minor premise: 0 proposition– $SM \neq 0$

Conclusion: 0 proposition– $SP \neq 0$

Let us represent the Syllogism diagrammatically–

In the diagram we have seen that major premise $MP = 0$, being a universal proposition shaded out the two interesting areas of SPM and $\bar{S}PM$. The minor premise $\bar{S}M \neq 0$ shows that the area which is in S but not in M is not empty. So, we have to put an x in either of $S\bar{P}\bar{M}$ or $SP\bar{M}$ area. So, we have to put an x between these two areas. Thus, we put the x on the line between these two areas. But this x does not necessarily show that it is the area for the conclusion $S\bar{P} \neq 0$. As such the given argument is invalid.



**CHECK YOUR PROGRESS**

**Q.4:** What is mood?

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**Q.5:** What is figure?

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**Q.6:** What is first figure?

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**Q.7:** Name the valid moods of first figure.

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**Q.8:** Fill in the blanks:

a) DARAPTI is a valid mood of ..... figure.

b) BRAMANTIP is a valid mood of ..... figure.



## 3.10 LET US SUM UP

- Aristotelian deductive logic is primarily concerned with syllogistic reasoning.
- A syllogism is any deductive inference that has exactly two premises and a conclusion.
- Syllogistic reasonings are of various types. A categorical syllogism is an inference constructed entirely of categorical statements. A Standard-form of categorical syllogism is such type of categorical syllogism which is constructed entirely of standard-form of categorical propositions (either A, E, I or O) and arranged in specified standard order. It contains exactly three terms, each of which is used two times.
- The form of a standard form of categorical syllogism is determined by its mood and figure.
- To test the validity of standard form of categorical syllogism by the Venn diagram technique three overlapping circles are drawn. We diagram both the premises but not the conclusion. Then we check whether the conclusion is entailed by the premises or not. If the conclusion is entailed by the premises then the argument is considered to be valid.



## 3.11 FURTHER READING

1) Baronett, S. and Sen, M.; *Logic*.

2) Chakraborti. C.; *Logic-Informal, Symbolic & Inductive*.

3) Copi, I. M. & Cohen, C.; *Introduction to Logic*.

4) Hurley, J. P.; *Introduction to Logic*.

5) Sharma. B. and Deka J.; *A text Book of logic*.

## 3.12 ANSWER TO CHECK YOUR PROGRESS

**Ans. to Q. No. 1:** A Standard-form categorical syllogism is a categorical syllogism in which the premises and conclusion are all standard – form categorical propositions (either A, E, I or O) and are arranged in specified standard order.

**Ans. to Q. No. 2:** A standard form categorical syllogism consists of two premises and one conclusion. It consists of three terms. They are: major term, minor term and middle term. The premise in which the major term occurs with the middle term is called the major premise. The premise in which the minor term occurs with the middle term is called the minor premise.

**Ans. to Q. No. 3:** a) The term that occurs in both the premises but absent from the conclusion is called the middle term.

b) The term that occurs as the predicate of the conclusion is called the major term of the syllogismc.

c) The term that occurs as the subject term of the conclusion is called the minor term of the syllogism.

**Ans. to Q. No. 4:** Mood is a form of syllogism determined by the quality and quantity of the constituent premises of a standard form categorical syllogism

**Ans. to Q. No. 5:** Figure is a form of syllogism determined by the position of the middle term in the premises.

**Ans. to Q. No. 6:** In the first figure the position of the middle term is the subject in the major premise and the predicate in the minor premise.

**Ans. to Q. No. 7:** BARBARA, DARII, CELARENT, and FERIO.

**Ans. to Q. No. 8:** a) Third, b) Fourth



## 3.13 MODEL QUESTIONS

**A) Very short questions:**

**Q.1:** What is mood?

**Q.2:** What is figure?

**Q.3:** Define middle term.

**Q.4:** What do you mean by standard form of categorical syllogism?

**B) Short questions: (Answer each question in about 150 words)**

**Q.1:** Write short notes on:

a) Middle term

b) Venn diagram technique

**Q.2:** Explain briefly the concept of figure.

**Q.3:** What do you mean by the concept of mood in syllogism? Explain in brief.

**C) Long questions: (Answer each question in about 200-300 words)**

**Q.1:** What is standard form of categorical syllogism? Explain its nature and structure.

**Q.2:** What is figure? Describe the figures of a syllogism with proper symbolic form.

**Q.3:** What is Venn diagram technique? Discuss this technique for testing syllogism with suitable examples.

**Q.4:** What is 'mood'? Explain.

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