

GENERAL SCIENCE

PHYSICS

- ✿ Nature of Universe and Space Science
- ✿ Measurement
- ✿ Motion and Energy
- ✿ Laws of Motion
- ✿ Fluids
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- ✿ Magnetism and Electromagnetism
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- ✿ Thermal Physics
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NATURE OF UNIVERSE AND SPACE SCIENCE

Introduction :

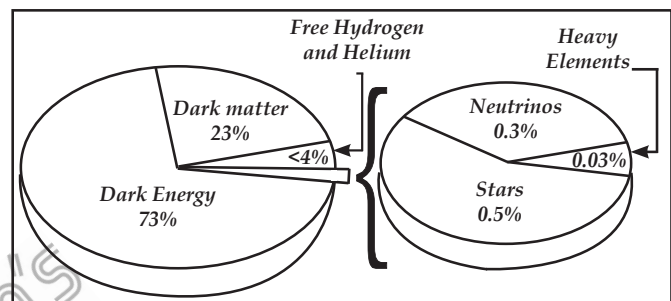
- ◆ In ancient days, it was believed that the earth was at the centre of the universe and the moon, the planets, the sun and stars were orbiting around it. This model was put forth by the Greek philosopher Plato and his disciple Aristotle in 6th century B.C. It was standardized by a Greeco Roman mathematician Ptolemy in the 2nd Century A.D. In India a similar model can be seen in the Siddhanthic astronomy in Aryabhata's Aryabhateeyam.
- ◆ In 16th century, a polish priest and astronomer named **Nicolaus Copernicus (1473-1543 AD)**, stated that the sun was at the centre of the solar system and the planets revolves around it. This theory is known as **heliocentric model (helios = sun)**. Even Copernicus hesitated to publish his work. His theory was however published in the year of his death in 1543 AD.
- ◆ Invention of the telescope in the Netherlands, in 1608 AD created a revolution in astronomy. In 1608, Galileo designed his own telescope, through this telescope he observed moons of Jupiter, phases of Venus and rings of Saturn. He argued that all the planets orbits the sun and not the earth.

Building block of the Universe

- ◆ The universe contains everything that exists today including planets, stars, space and galaxies. This includes all matter, energy and even time. **Galaxies are collection of billions of stars**. It is beyond the bounds of possibility to know exact size of the universe. It could be infinitely large. However, scientists to some extent tried to measure the size of the universe by what they can actually see. This is called the '**observable universe**'. The observable universe is around 93 billion light years (1 light year is equal to the distance that light travels in one year, which is 9.4607×10^{12} km).
- ◆ It is interesting to know that the universe is just expanding. It is growing larger and larger all the time. In 1929, Edwin Hubble, an astronomer at California Institute of Technology, made a critical discovery that universe is expanding. Once scientists understood that the universe was expanding, they immediately realized that it would have been smaller in the past. At some point in past, the entire universe would have been a single point. This point, later exploded with unimaginable force called event of **big bang**, and it was the beginning of the universe as we understand it today. However, most of the universe what we think of is empty space. All the atoms together make up only around **4% of the universe**. The majority of the universe consists of something scientists call as **dark matter and dark energy**.

Difference between normal matter and dark matter

Normal matter	Dark matter
Normal matter or baryonic matter can be broken down into sub-atomic particles called leptons (for example electron) and quarks (the building blocks of protons and neutrons). These are what make up the atoms and molecules which are the components of everything from humans to stars.	In contrast with normal matter, dark matter is material that is non-luminous. That is, it does not interact electromagnetically and therefore it appears dark (i.e it will not reflect or give off light).
Normal matter is Luminous, that is, it interacts electro magnetically and gravitationally with other matter and with radiation. It doesn't necessarily shine like star. It may give off other radiation (such as infrared).	The exact nature of dark matter is not well known, although its effect on other masses (such as galaxies) has been noted by astronomers such as Dr. Vera Rubin and others. However, its presence can be detected by the gravitational effect it has on normal matter. For instance, its presence can constrain the motions of star in galaxy.



Cosmological Composition

Age of the Universe :

- ◆ Scientists believe that the universe came into being after a massive explosion called the **Big Bang**. According to Big Bang Theory ; In the beginning, all matter forming the universe existed in one place in the form of a "**tiny ball**" (**singular atom**) with an unimaginably small volume, infinite temperature and infinite density. After several years the "tiny ball" exploded violently. This led to huge expansion. It is now generally accepted that the event of big bang took place **13.7 billion years before the present**. We know that expansion continues even to the present

day. As it grew, some energy was converted into matter. There was particularly rapid expansion within fractions of a second after the bang. Thereafter, the expansion has slowed down. Within first three minutes from the Big Bang event, the first atom began to form.

- ◆ Within 300,000 years from the Big Bang, temperature dropped to 4,500K (Kelvin) and gave rise to atomic matter. The universe became transparent. The expansion of universe means increase in space between the galaxies. An alternative to this was **Hoyle's concept of steady state**. It considered the universe to be roughly the same at any point of time. However, with greater evidence becoming available about the expanding universe, scientific community at present favours argument of expanding universe.

Formation of Universe

Time/year	Event
0	Big Bang
10^{-32} seconds	Cosmic Inflation (origin of fluctuations)
1 second	Particles formation
100 seconds	Ordinary matter particles are coupled to light. And dark matter particles start building structures.
380000 years	Recombination (ordinary matter particles decouple from light and the cosmic microwave background is released)
From 380000 years to 200 million years	Dark ages (ordinary matter particles fall into the structures created by dark matter)
200 million years	First stars & galaxies
10 billion years	Galaxy evolution (Clusters of galaxies and super clusters formation)
13.82 billion years	Today

Galaxies

- ◆ In the beginning, all matter forming the universe existed in one place in the form of tiny ball. The distribution of matter and energy was not present in the early universe. These initial density differences gave rise to differences in gravitational forces and it caused the matter to get drawn together. These formed the bases for development of galaxies.
- ◆ A galaxy is a massive collection of gas, dust and billions of stars. Galaxies spread over vast distances that are measured in thousands of light-years. The diameters of individual galaxies range from 80,000 – 150,000 light years.
- ◆ **Scientists believe that there are one hundred billion (10^{11}) galaxies in the observable universe.**

Galaxies are also in different shapes. Depending on their appearance, galaxies are classified as spiral, elliptical or irregular. Galaxies may present alone or in pairs and also in parts of groups, clusters and super clusters. Galaxies in groups would interact and even merge together.

- ◆ Our solar system is a part of the "**Milky way galaxy**". In ancient times, it was imagined to be a river of light flowing in the sky. Thus, it was named **Akash Ganga**. There are several galaxies besides our milky way galaxy. **The Andromeda Galaxy**, also known as Messier 31, (M31) or NGC 224 is a spiral galaxy approximately 780 kiloparsecs from Earth and the nearest major galaxy to the milky way galaxy. Milky way galaxy is spiral in shape. Our solar system is 25,000 light years away from the centre of our galaxy.

A light year is a measure of distance and not of time. Light travels at a speed of 300,000 km/second. Considering this, the distance the light that travels in one year is taken to be one light year. This equals to 9.461×10^{12} km. The mean distance between the sun and the earth is 149,898,000 km. In terms of light years, it is 8.311 minutes.

Stars

- ◆ The formation of stars is believed to have taken place some 5-6 billion years ago. Stars are the most widely recognized astronomical objects and represent the most fundamental building blocks of galaxies.
- ◆ Stars are formed within the clouds of dust and scattered throughout in most galaxies. Stars produce heat, light, ultraviolet rays, x-rays and other forms of radiation. However, stars are responsible for the formation and distribution of heavy elements such as carbon, nitrogen and oxygen. Stars are largely composed of gas and plasma (a superheated state of matter) and are built by hydrogen gases. Over 3,000 stars can be seen in a dark night with the naked eye. It is impossible to predict the exact number of stars. It is generally believed our universe constitutes more than 100 billion galaxies and each of those galaxies may have more than 100 billion stars.
- ◆ Stars may appear to be alone, however most of the stars exist as pairs. The brightness of a star depends on their intensity and the distance from the Earth. Stars also appear to be in different colours depending on their temperature. Stars with higher temperature looks white or blue, whereas cooler stars looks orange or red in colour.

Constellations

- ◆ The stars forming a group that has a recognisable shape is called a constellation. They represent an animal, mythological personalities or creature, a god or an object. One of the most famous constellations which we can see during summer time in the early part of the night is **Ursa Major**. It is also known as the Big Dipper, the Great Bear or the Saptarshi.

- ◆ Ursa minor is sometimes informally called the little Dipper, because it looks like a smaller and fainter version of the Big Dipper (ursa major). Its brightest star, at the tip of the ladle's handle is polaris, the pole star. There are formally 88 constellations as accepted. Some of them are ; **Aries, Gemini, Leo, Orion, Scorpius and Cassiopeia.**

Polestar

- ◆ A pole star also known as polar star, preferably bright, closely aligned to the axis of rotation of an astronomical object. Currently, '**Polaris (ursae minoris)**' is designated as the north star or pole star. (It is the brightest star in the constellation of ursa minor). It is very close to the north celestial pole, making it the current northern pole star. Sailors and travellers have used it for navigational purposes for centuries because of its constant - seeming position in the sky.
- ◆ There is no such pole star for the southern celestial pole.

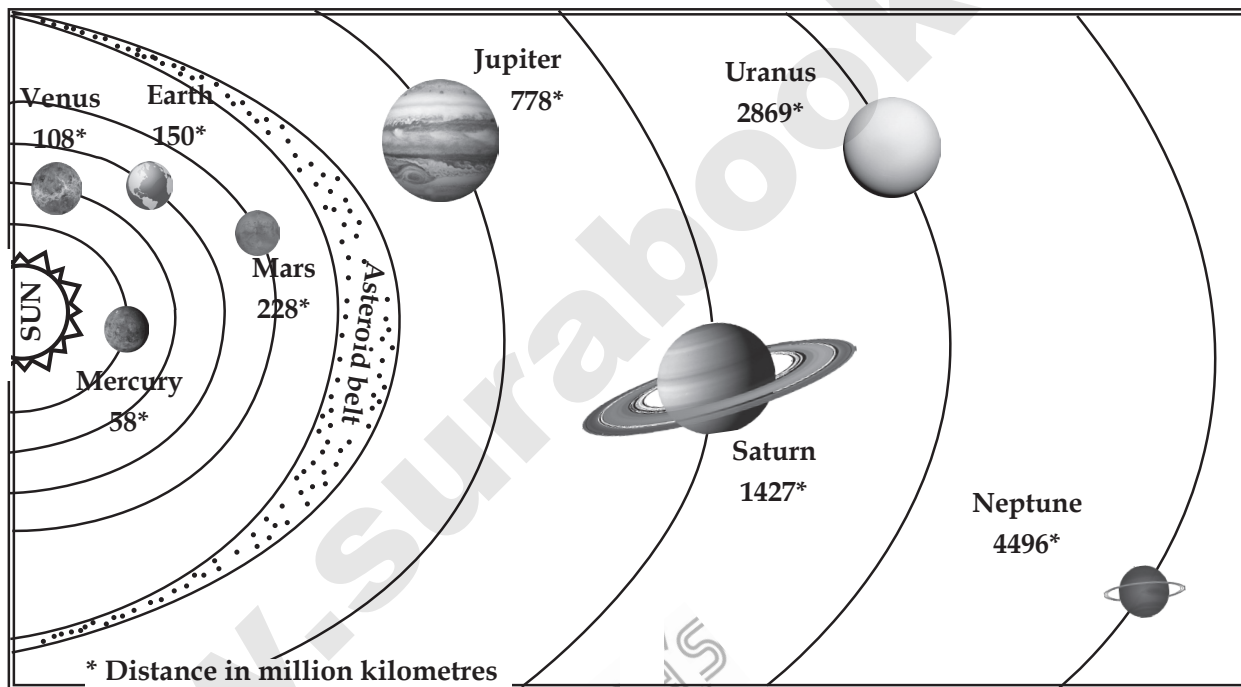
The solar system

The Sun and the celestial bodies which revolve around it form the solar system. It consists of many number of bodies such as planets, comets, asteroids and meteors. The gravitational attraction between the sun and these objects keeps them revolving around it.

Our solar system consists of eight planets. The nebula from which our solar system is supposed to have been formed, started its collapse and core formation started, some time (5-5.6 billion years) ago and planets were formed about 4.6 billion years ago.

The Sun

The Sun is a yellow dwarf star, a hot ball of glowing gases at the heart of our solar system. Its gravity holds the solar system together, keeping everything – from the biggest planets to the smallest particles of debris - in its orbit. The connection and interactions between the Sun and Earth drive the seasons, ocean currents, weather, climate, radiation belts and auroras. The sun accounts for 99.8% of the mass of the entire solar system.



The Solar System

Inner planets - very close to the sun. They are made up of rocks.	Outer Planets - Very-very far from the sun and are huge planets made up of gases and liquids.
Mercury : One orbit around sun - 88 days, One spin on axis - 58.65 days.	Jupiter : One orbit around sun - 11 years, 11 months (around 12 years). One spin on axis - 9.92 hours, number of moons - 79
Venus : One orbit around sun - 255 days, One spin on axis - 243 days	Saturn : One orbit around sun - 29 years, 5 months. One spin on axis - 10.23 hours, number of moons - 82.
Earth : One orbit around sun - 365 days. One spin on axis - 23.93 hours, Number of moons - 1	Uranus : One orbit around sun - 84 years. One spin around axis - 17 hours, number of moons - about 27.
Mars : One orbit around sun - 687 days, One spin on axis - 24.62 hours, number of moons - 02	Neptune : One orbit around sun - 164 years. One spin on axis 18 hours, number of moons - 14.

POLITICAL THOUGHTS

INTRODUCTION TO POLITICAL SCIENCE

- ◆ The word 'Politics' is closely related to 'Polis' in Greek it means 'city state'.
- ◆ The systematic study of politics dates back to 5th Century B.C.
- ◆ Political philosophers such as 'Socrates' (470 - 399 BC), Plato (428 - 347 BC) and Aristotle (384 - 322 BC) contributed immensely to politics and its study.
- ◆ Politics, as a separate study or branch emerged during 20th century AD only. Earlier it had been merged with history and philosophy.
- ◆ Politics was primarily concerned with ethics. Slowly, it became a study of relationship between states, political institutions, ideas etc.

Power is a relationship in which one group of persons is able to determine the actions of the others in the direction of the former's own end. - **David Easton**

- ◆ In the last two centuries (19th & 20th) its concentration revolved around liberty and equality.
- ◆ In the 21st century, the central theme of politics revolves around the study of conflict between liberty and security. Recently politics has started concentrating on development, environment, gender equality and international peace and co-operation.
- ◆ It was Aristotle who made a systematic study of politics and tried to explain the relationship between the state and the individual. He only classified different political systems.
- ◆ **Plato** analysed different political systems and Aristotle, his student, closely following the footsteps of his teacher gave the analysis, a historical perspective. They tried to understand the working of different forms of government.

There is a limited amount of power in society, which can only be held by one person or group at a time - **Karl Marx**

- ◆ **Aristotle** believed that happiness and not pleasure is the most sought after in one's life. Happiness lies in ourselves and not in the outside world.
- ◆ **Aristotle** said, "happiness is the meaning and the purpose of life, the whole aim and end of human existence".
- ◆ In ancient times politics was discussed in church which had a great role in Roman Empire.
- ◆ The works of philosophers such as **St. Augustine**, the author of '**The city of god**', amalgamated both politics and religion. Greek and medieval philosophers were more concerned with city states which were not states of present day stature, but were more a community. Athens and Sparta were city states. All the people of the city gathered on a slopy place or hill to take a decision.

- ◆ It was **Niccolo Machiavelli**, a philosopher of Italian Renaissance laid foundations for modern politics. His empirical observations and investigation of political structures made to understand politics from secular perspective.

◆ **Harold Lasswell**, an American political scientist said that politics is "**Who gets, What, When and How ?**" His theory is based on the assumption that all societies exhibit sharp diversities with people pursuing different interests and values. Hence a mechanism is to be devised so that all the conflicting interests are reconciled. Modern societies are in the scarcity of resources, hence politics is expected to distribute the resources evenly to satisfy the needs of all.

- ◆ **Karl Marx** saw politics was all about class conflict and political power.
- ◆ **David Easton** meant that politics is authoritative allocation of values.

Power breeds power and this forms the central tenet of elitism. - **Robert Michel**

- ◆ Politics can be explained through power, order and justice. There is a difference between power and authority. Authority is the legal and moral right and the ability to control. It implies legitimacy. But power is exercised through established institutions. Power on the other hand may be legitimate or not.
- ◆ Power is concerned about order, as the majority is always ruled by the minority and concerned about the apprehension of the fairness of the government mechanism. Therefore, the exercise of power should be based on justice. Thus, power, order and justice are basic concepts of politics.
- ◆ Since 19th century, the study of politics, as academic discipline is commonly referred to as 'political science'.

Man is by nature a political animal and he, who by nature and not by mere accident is without state is either above humanity or below it. - **Aristotle in his book Politics**

- ◆ We must make a clear difference between 'politics' and 'political science'. One who is involved in politics means that he is involved in day to day political or particular party or labour activities. Further the political activities differ from country to country. But the meaning of political science is one and the same throughout the world. It is a systematic study of governmental institutions and relationship between the state and the people.
- ◆ The political scientists who met at **Paris in 1948** also found the term 'Political Science' more acceptable than using the word 'Politics'.

- ◆ The discipline of 'Political Science' found a separate identity in 1880 when John. W. Burges established a school of political science at the Columbia University. By 1920's most of the universities world-wide established political science departments and schools in all western universities. The American political scientists showed tremendous interest, since then this discipline had very formalistic and institutional approach until II world war.
- ◆ After II world war, the scope of political science warranted the study of socio-economic behaviours of people and not only the institutions of politics. Political scientists such as Woodrow Wilson, 'Frank Goodrow', Arthur Benteey, Charles. E. Marian emerged with theories of **behaviouralism**. Works during this time concentrated on totalitarian regimes and groups of 1920s and 30s. This new focus was termed as 'behaviouralism'. The 1960s witnessed an emergence of a trend known as 'Post Behaviouralism'. It was against orthodoxy and dominance of behavioural methods to study politics. It devised way for study of sociological, anthropological and psychological aspects of the study of political science.

Political Science is a science which is concerned with the State, endeavours to understand and comprehend the State in its essential nature, various forms, manifestations and development.
- **Bluntschli**

- ◆ The new political scientists criticized that the traditional methods and parochial approach concentrated on state, government, institutions and their formal structures did not take into consideration the interactions between them and the subjects. Hence the modern political science approach is based on **(1) the search of comprehensive scope (2) the search for realism (3) the search for precision (4) the search for intellectual order.**

Political Science investigates the phenomena of government as Political Economy deals with Wealth, Biology with Life, Algebra with Numbers and Geometry with Space and Magnitude.
- **Seeley**

Definitions of Political Science

Scholars have defined political science in different ways.

- ◆ It begins and ends with state – **Garner**
- ◆ It is dealing with government - **Leewek and Seelay**
- ◆ It is a study of power and influence – **Robson and Lasswell**
- ◆ But all these definitions have undergone great changes. Behavioural revolution entered into this bringing individuals and groups into play. The latest addition is 'concept of governance'.

Nature of Political Science

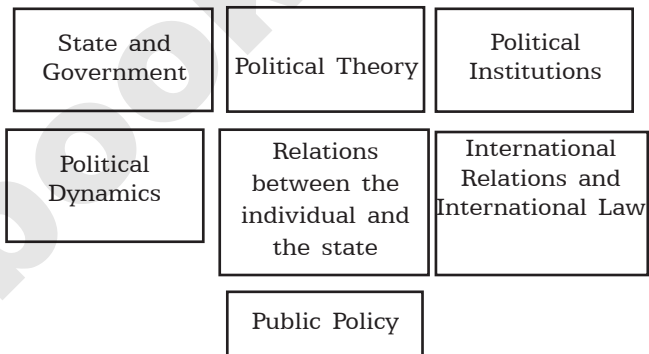
- ◆ Man is a social animal. He cannot live in solitude. He always needs company to exchange ideas and material things as he can never be self-sufficient.

When in a society, he has to create and abide by certain rules and regulations. They have to give and take. To ensure this activity go smoothly, he needs a social contract. Thus the society organised is what is called 'State'.

- ◆ The Political Science deals with the relationship of individual and state. It is the study of humans in the process of governing themselves.
- ◆ Political Science is concerned with the theory, evolution and practice of politics through the ages.

Scope of Political Science

- ◆ State is a territory with people. Hence the Political Science is a study of state in total. It cannot be an isolated study of politics only. As change is permanent in the society, the political science has to include fields like economics, commerce, sociology, law, etc.
- ◆ The 1948 conference mentioned **(1) Political Theory, (2) Political Institutions, (3) Political dynamics and (4) International Relations** as the scope of Political Science.
- ◆ Now further sub-divisions are included as given



Political Science deals with the origin, development, purpose and all political problems of the State.
- **Garris**

- ◆ Political Theory is an important component of Political Science. It includes political thought and philosophy.

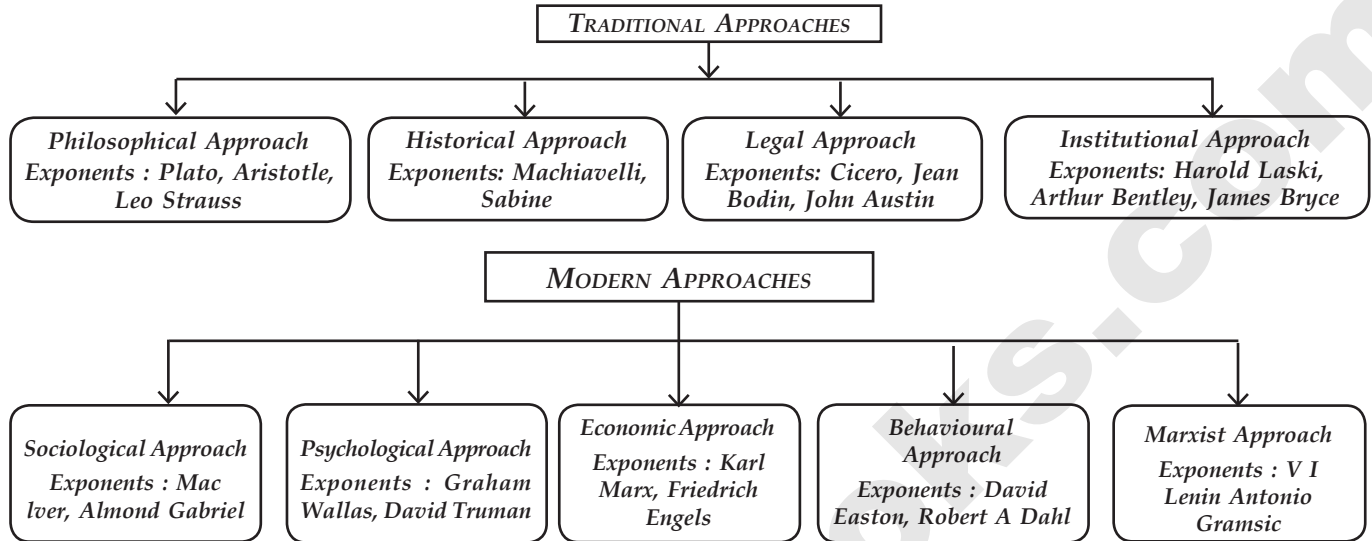
Political Science - a Science or an Art

- ◆ In Science, there can be only one definite theory, unless otherwise proved wrong. But in Political Science, different theories exist always – some are contradictory and some are complementary. No definite explanations can be given as we find in Natural or Physical Sciences. There is no uniformity of rules or principles in Political Science. Similarly, we do not have exactness and absoluteness in Political Science as we find in biological or physical sciences.
- ◆ On the other hand, some writers argue that it is a science of state and government. Aristotle was the first to call it as science. His was endorsed by 'Bodin, Thomas Hobbes, Montesque and Bluntschli. They argue that it is science that deals with various forms of government. As Science, it has evolved over various forms of government to the present system of democracy. Even democracy is not the ultimate form of government. As other Sciences, Political Science is also dynamic.

◆ Political Science is also concerned with cause and effect (E.g.) Poverty and unemployment. Though it cannot fit into science exactly, it is also a subject matter of study as Science.

Political Science is the process by which scarce resources-human, economic, spiritual are allocated within a social limit, be it a city, a state, a nation or an organization for the purpose of providing for human needs and desires. - **David Easton**

Approaches to the study of Political Science



Traditional Approaches

(i) Philosophical Approach

It is closer to ethics. Truth and morality are interwoven. This approach is criticised for being highly speculative and abstract.

Political Science is an empirical enquiry in the study of shaping and sharing of power. - **Harold Laswell**

(ii) Historical Approach

It throws light on older institutions and traces their origin and metamorphosis. The future system is built on experiments and failures of earlier institutions. Critics argue that the historical parallels are illuminating only and as it is loaded with superficial resemblances, they are misleading.

(iii) Legal Approach

It asserts that the institutions of government are for the maintenance of law and order via justice. Hence the study of judicial institutions are primary for study of Political Science. But it is argued that state has many other functions other than maintenance of law and order.

The study of Politics concerns itself with the life of men in relation to organized states. - **Harold Laski**

(iv) Institutional Approach

It is concerned with Legislature, executive and judiciary. The informal structures are also studied. However, it is criticised on the ground that it ignores the role of individuals in those institutions.

It is the historical study of the past, analytical study of the present and ethical study of the future. - **Gettel**

Modern Approaches

(i) Sociological Approach

It forces to study political behaviour in social context. The state is primarily a social organisation. But too much emphasis on social context will affect the autonomy of the discipline.

(ii) Psychological Approach

Psychological laws and analysis of political leaders are given importance. But it ignores sociological, economic and legal factors of politics.

(iii) Economic Approach

As the state is primarily concerned with production and distribution of goods, the role of the state is regulation of economic affairs. However as other factors are ignored, it cannot be a correct approach.

(iv) Behavioural Approach

This approach is based on preferences and attitudes of the individuals in the political context. But this approach is based on false conception of scientific approach.

(v) Marxist Approach

It says that there is always a continuous interaction between political and economic forces and these two cannot be separated from each other. But this approach gives undue importance to economic factors.

NOW WE CAN CONCLUDE ALL THE APPROACHES HAVE THEIR OWN MERITS AND DEFECTS.

Relationship with Social Sciences

(i) Political Science and History

◆ The present state and political institutions are fruits of historical growth. The History and Political Science

