MODEL SET-3

SECTION-II (NON-OBJECTIVE TYPE QUESTIONS)

Question Nos. 1 to 11 are of short answer type. Each question carries 2 marks. 11 × 2 = 22

SHORT QUESTIONS

1. Define electric dipole moment and write its SI unit ?

Ans.—Electric dipole moment—Electric dipole moment of an electric dipole is defined as the product of the magnitude of either charge of the electric dipole and the dipole length. Mathematically, the magnitude of dipole moment is

$P = q \times 2l$

It is a vector quantity. The SI unit of electric dipole moment is coulomb metre (cm).

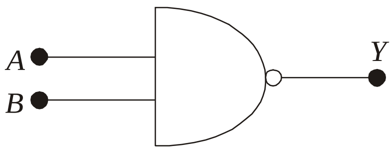
2. Write two characteristics of LASER rays ?

Ans.—Two characteristics of LASER rays are as follows—

1. It is highly directional with parallel beam.
2. It is monochromatic and coherent.

3. Write logic symbol and truth table of 'NOR' gate?

Ans.—The logic symbol of NOR gate is as follows—



Truth table of NOR gate is as follows—

Input		Output
A	*B*	*Y*
0	0	1
0	1	0
1	0	0
1	1	0

4. Define magnetic flux and write SI unit of magnetic flux ?

Ans.—Magnetic flux—It is defined as the number of magnetic field lines passing through a surface.

It is denoted by ϕ

The S.I. unit of magnetic flux is weber (wb).

5. State Biot-Savart law. Mention its expression ?

Ans.—Biot-Savart's law—It states that, the magnitude of the magnetic field dB is proportional to the current I, the element length dl, and inversely proportional to the square of the distance r and its direction is ⊥' r to the plane containing dl and r.

Mathematically, it can be expressed as

$$\boxed{dB = \frac{\mu_0}{4\pi} \cdot \frac{Idl \sin\theta}{r^2}}$$

6. Define critical angle. State two conditions of total internal reflection of light ?

Ans.—Critical angle—The angle of incidence corresponding to which angle of refraction becomes 90º is called critical angle.

Following are the two conditions of total internal reflection of light—

1. The light should travel from denser to rarer medium.
2. The angle of incidence must be greater than the critical angle for the given pair of media.

7. Name the energy losses in a transformer?

Ans.—Energy losses in a transformer are as follows—

1. Copper losses,
2. Flux bakage losses,
3. Eddy currents losses,
4. Hysteresis losses,
5. Losses due to vibration of core.

8. Define nuclear fission reaction. Mention its nuclear reaction which take place in nuclear reactor ?

Ans.—Nuclear fission reaction—A nuclear reaction in which a nearly nucleus of U-235 is splits up into light nuclei as a when a slow moving neutron is bombaraded it and it releases large amount of nuclear energy, which is called nuclear fission reaction.

The reaction is as follows—

$${}_{92}U^{235} + {}_0 n^{'} \xrightarrow[\text{moving neutron}]{\text{Slow}} {}_{56}Ba^{139} + {}_{36}Kr^{94} + 3{}_0 n^{'} + \text{large amount of energy}$$

9. Define modulation. Write its types.

Ans.—Modulation—The process of mounting a very low frequency signal over high frequency signal is known as modulation.

Following are the different types of modulation which are as follows—

1. Amplitude Modulation,
2. Frequency Modulation,
3. Phase Modulation,

10. Calculate the frequency associated with a photon of energy 3.3×10^{-20} J. ($h = 6.6 \times 10^{-34}$ JS)

Ans.—Given that,

E = 3.3×10^{-20} J

h = 6.6×10^{-24} Js

ν = ?

As we know that,

$$\boxed{E = h\nu}$$

$$\therefore \quad \nu = \frac{E}{h}$$

$$= \frac{3.3 \times 10^{-20}}{6.6 \times 10^{-34}}$$

$$=\frac{1}{2}\times10^{-20}\times10^{34}$$

$$=\frac{10}{2}\times10^{-20}\times10^{33}$$

$$\boxed{\nu=5\times10^{13}\,\text{Hz}}$$

11. Calculate the radius of a nucleus of mass no. 8.

Ans.—As we know that

$$\boxed{R=R_0\text{A}^{\frac{1}{3}}}$$

$\therefore$ $R = 1.2 \times 10^{-15} \times (8)^{1/3}$

$$=1.2\times10^{-15}\times(2)^{3\times\frac{1}{3}} = 1.2 \times 10^{-15} \times 2$$

$$\boxed{R=2.4\times10^{-15}\,\text{m}}$$

Given that,

$R_0 = 1.2 \times 10^{-15}$ m

A = 8

R = ?

SECTION-II (NON-OBJECTIVE TYPE QUESTIONS)

Question Nos. 12 to 15 are of long answer type. Answer must be explantory and in your own language. Each question carries 5 marks. 4 × 5 = 20

LONG QUESTIONS

12. State and explain different types of Telescope. With the help of neat and labelled diagram explain the working and magnifying power of an Astronomical telescope ?

Ans.—TELESCOPE—An optical instrument which is used to see far off objects clearly and distinctly is called telescope. There are two types of telescope.

I. Refracting type Telescope—A telescope in which lenses are used is called refracting type telescope.

There are two types of refracting type telescope.

(a) Astronomical telescope—A telescope which is used to see havenly objects such as sun, moon, stars, commets etc is called astronomical telescope.

(b) Terrestial telescope—A telescope which is used to see earthly objects such as mountain, hills, plateaus, sea, etc is called terrestial telescope.

II. Reflecting type Telescope— α

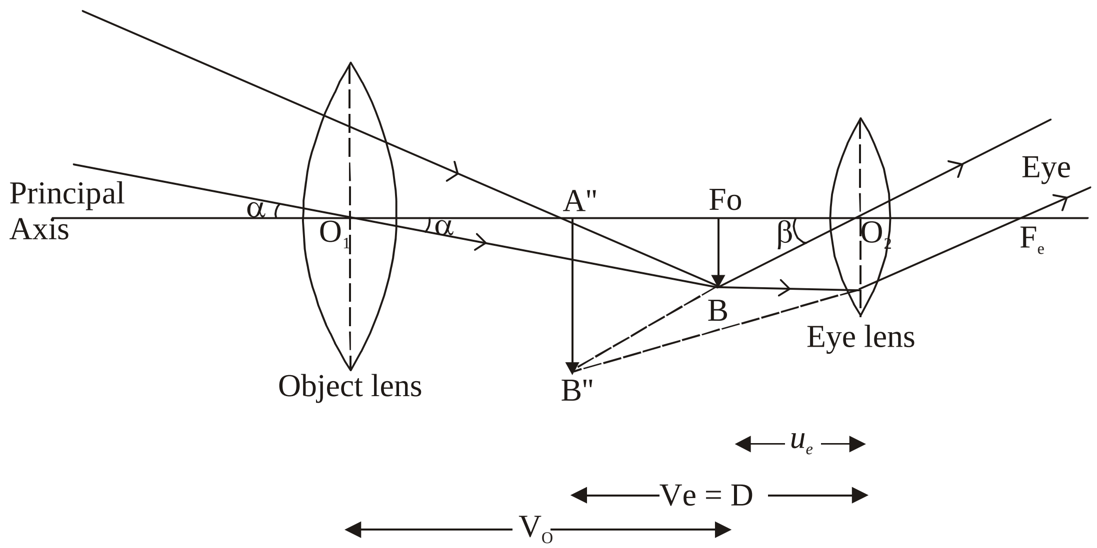
A telescope in which mirror is used is called reflecting type telescope.

There are two types of reflecting type telescope.

(a) Newtonian Telescope.

(b) Cassegrain Telescope.

ASTRONOMICAL TELESCOPE



It is an optical instrument which is used to see havenly object such as sun, moon, stars, etc is called astronimcal telescope.

Principal—If object is placed at α its image is formed at focus. A'B' behave like an object for eye lens whose virtual erect, highly magnified image is formed in the same side of object.

CONSTRUCTION & WORKING—It is in an astronomical telescope two lens are used. The lens facing the object is called object lens. Its focal length and aperature is very large. The lens facing the eye is called eye lens. Its focal length and aperature is small. Both the lens are placed co-axially.

Magnifying power or magnificaiton—It is the ratio of angle substended by the eye to see the image (β) to the angle substended by the eye to see the object (α). Magnification or M.P.

$$M.P. = \frac{\beta}{\alpha} \quad \ldots(1)$$

For smaller angle,

$$\left.\begin{aligned} \beta &= \tan\beta \\ \alpha &= \tan\alpha \end{aligned}\right] \quad \ldots(2)$$

$$\therefore \quad M.P. = \frac{\tan\beta}{\tan\alpha} \quad \ldots(3)$$

In $\Delta O_2A'B'$

$$\tan\beta = \frac{A'B'}{O_2A'} \quad \ldots(4)$$

In $\Delta O_1\, A'B'$

$$\tan\alpha = \frac{A'B'}{O_1A'} \quad \ldots(5)$$

Using in eqn (3)

$$M.P. = \frac{A'B'}{O_2A'} \times \frac{O_1A'}{A'B'}$$

$$\therefore \quad M.P. = \frac{O_1A'}{O_2A'} \quad \ldots(6)$$

Using proper sign-convention

$$\left.\begin{aligned} O_1A' &= f_o \\ O_2A' &= -ve \end{aligned}\right] \quad \ldots(7)$$

Using in eqn. (1)

$$M.P. = \frac{-f_o}{-u_e}$$

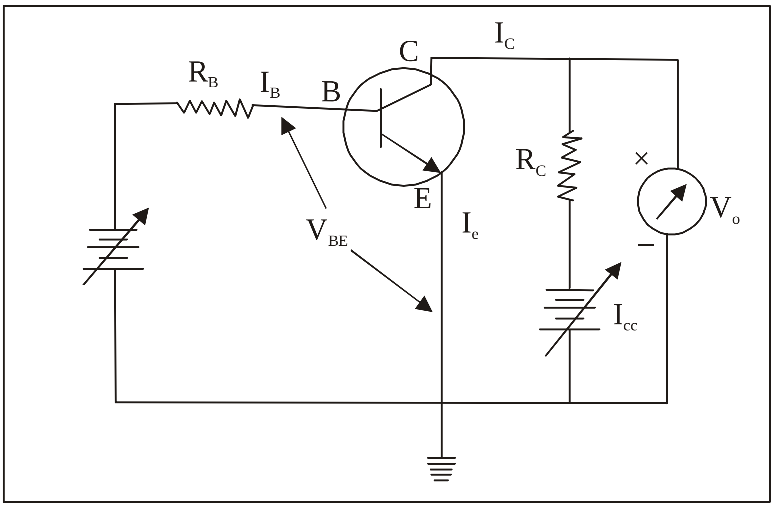
$$\therefore \quad M.P. = \frac{-f_o}{u_e} \quad \ldots(8)$$

Equation (8) is the general equation for magnification produced by an astronomical telescope.

13. Explain transistor as a switch and transistor as an amplifier ?

Ans.—Transistor as a Device—Transistor can be used as a switch when it operators in cut off region (open switch) and saturation region (closed switch). On the other hand, transistor is used as an amplifier to increase the magnitude of the output signal when it operators in the active region.

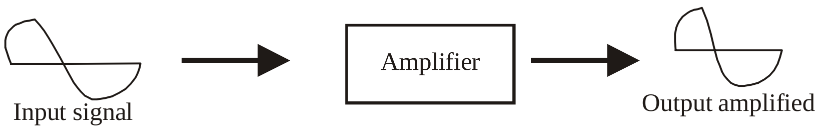
(I) Transistor as a switch—A device which turns ON or OFF electric current in an electric circuit is known as a switch. A transistor acts as a switch when it is driven back and forth between saturation and cut off regions. Circuit diagram showing transistor as a switch is shown in figure.



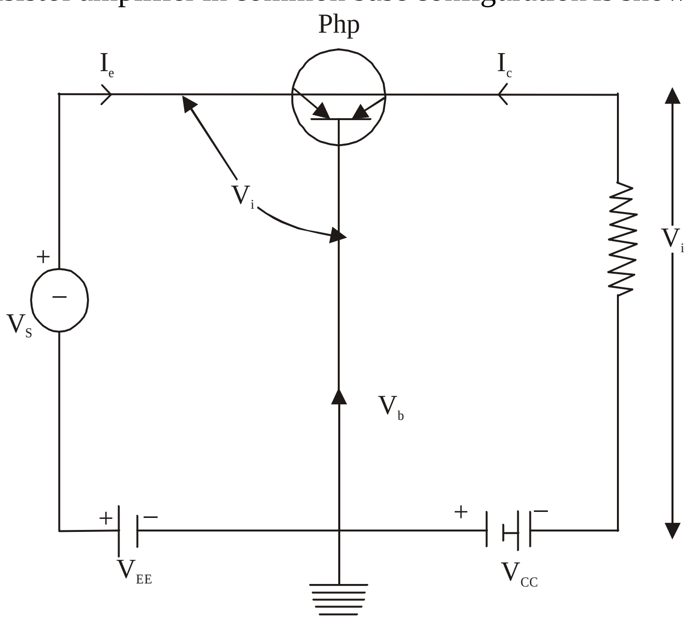
When base input voltage V_{BB} is very low so that the transistor is not forward bias, then no current flows through R_C i.e. I_C = O Hence, the output voltage = V_{CC}. The transistor is in the cut off mode and acts as an open switch i.e. OFF state. When base input voltage is enough positive, the transistor is forward biased. Therefore, the current I_C flows through R_C.In this situation, voltage drop across R_C = V_{CC}.Hence, $I_C = \frac{V_{CC}}{R_C}$ and V_{CE} = O Therefore the transistor acts as a closed switch i.e. ON state.

Transistor as an amplifier—A device which increases the amplitude of the input signal is called amplifier.

The weak input signal (i.e. a signal of small amplitude) is fed to the amplifier which is turns amplifiers it and we get output signal or large amplitude.



The basic circuit of βnp transistor amplifier in common base configuration is shown in figure.



Transistor is biased in the active region i.e. emitter-base junction is forward biased with a battery V_{EE} and the collector-base junction is reverse baised with a battery V_{CC}. The emitter-base circuit is known as input circuit and the collector-base circuit is known as output circuit. The signal voltage V_S to B_e amplified is fed to the input circuit. The output is taken across load resistance R_L in the output circuit. When signal voltage V_{EE}, then input voltage V_i is increased to ΔV_i. Due to this increased voltage, emitter current increases by ΔI_e. This will Increase the collector current by ΔI_C. Therefore, the output voltage across RL will increase to ΔV_C, Where,

$$\Delta V_C = \Delta I_C R_L$$

Since $\infty = \dfrac{\Delta I_C}{\Delta I_C}$ Or $\Delta I_C = \propto \Delta I_e$ …(i)

$\therefore \quad \Delta V_C = \propto \Delta I_e R_L$

If R_e is the resistance of input circuit, then

$$\Delta Vi = R_e \Delta I_e$$

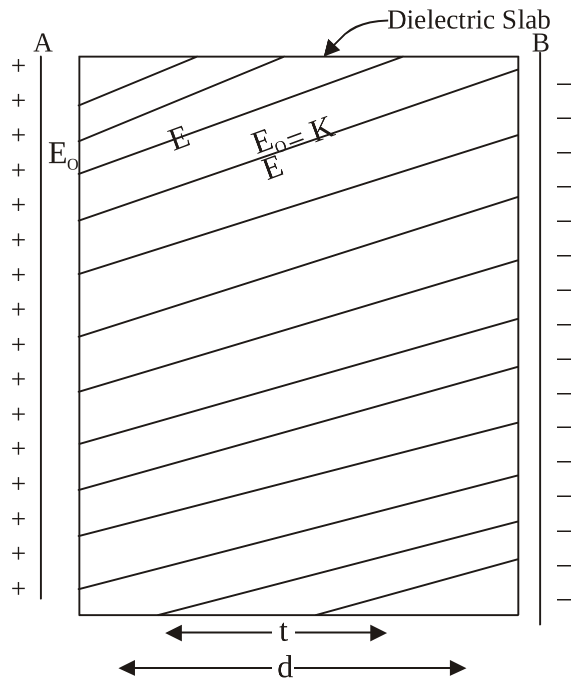
Thus, the voltage gain,

$$AV = \frac{\Delta V_C}{\Delta V_i} = \frac{\propto \Delta I_e R_L}{R_e \, \Delta I_e}$$

$$= \propto \left(\frac{R_L}{R_e}\right) \alpha$$

14. Deduce an expression for parallel plate capacitor with dielectric slab ?

Ans.—



If dielectric slab is not placed in between the plate of P.P.C. its capacitance.

$$\boxed{C_O = \frac{E_o dA}{d}} \quad \ldots(1)$$

Where, A is area of the plate

d is the distance between the two plates

Initial electric field is E_O.
Now, dielectric slab is placed in between the two plates of dielectric constant "K"
K is always '+ve' and greater than one
By def^n of polarisation.

$$\frac{E_o}{E} = K \qquad \ldots(2)$$

$$E = \frac{E_o}{K} \qquad \ldots(3)$$

From relation between electric field and potential.

$$E = \frac{-dv}{dr} \qquad \ldots(4)$$

Taking magnitude of eq^n …(4)

$$E = \frac{dv}{dr} \qquad \ldots(5)$$

If electric field is uniform,

dv = v
dr = r …(6)

$$\therefore \quad E = \frac{v}{r}$$

$\therefore$ V = Er …(7)

$V = V_1 + V_2$ …(8)

V_1 is for free space
V_2 is for dielectric slab.
From eqn…(7)

$V = E_1 r_1 + E_2 r_2$
$V = E_o(d - t) + E \cdot t$
From eq^n (3)

$$\boxed{V = E_o(d-t) + \frac{E_o}{K}\cdot t} \qquad \ldots(9)$$

But, $E_o = \frac{\sigma}{E_o} = \frac{9}{E_o A}$ …(10)

Using in eq^n…(9)

$$V = \frac{9}{E_o A}\left[d - t + \frac{t}{k}\right] \qquad \ldots(11)$$

By defn of capacitance of the capacitor

$$C = \frac{9}{V} \qquad \ldots(12)$$

$$C = \frac{9}{\frac{9\left(d - t + \frac{t}{k}\right)}{E_o A}}$$

$$\therefore \quad \boxed{C = \frac{E_o A}{\left(d - t + \frac{t}{k}\right)}} \qquad \ldots(13)$$

Eq^n (13) is the general equation for capacitance of d parallel plate capacitor with dielectric slab of dielectric constant 'K'.

Special case—If dielectric slab completely failed the plat.

$\therefore \quad d = t$ …(14)

$$C = \frac{E_o A}{\left(d - d + \frac{d}{k}\right)}$$

$$C = k\left(\frac{E_o d}{d}\right) \quad \ldots(15)$$

Using eqn …(1)

$$\boxed{C = KC_o} \quad \ldots(16)$$

Conclusion—If a dielectric slab is placed in between two plate of ppc its capacitance increases 'K' times in which k is positive and greater than one.

15. Define nuclear reactor. Discuss its different components with their functions. Draw diagram also.

Ans.—Nuclear-Reactor—An apptetus in which controlled nuclear chain reaction.

In a nuclear reactor the energy released through fission is ued to generate electricity serveral nuclear power for the generation of electricity are operating in India.

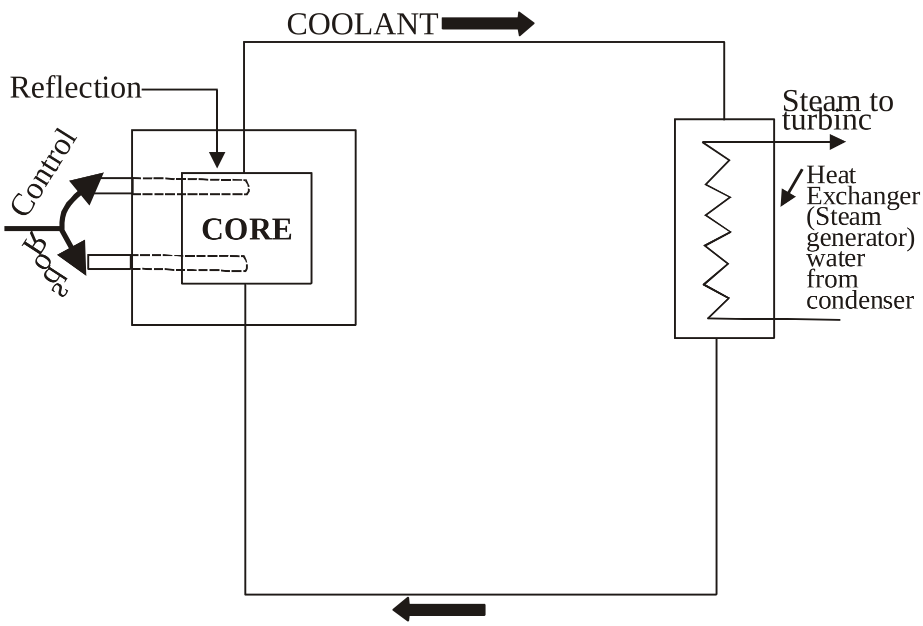
Following are the important components of nuclear reaction.

(i) Nuclear fuel (iii) Coolant (v) Radio active protection arrangement
(ii) Moderator (iv) Controlled rods

(i) Nuclear fuel—The elements undergoing fission in a reactor are called nuclear fuel. Uranium, Isotopes, Thorium. Isotopes and platanium Isotopes are most commonly used nuclear fuels.

(ii) Moderator—Moderator are used to slow down the fast moving neutrons are passed through moderator which are generally element of Low atomic number graphite, heavy water, berellium oxides etc are used as a moderator D_2O (Heavy water) is bets known moderator.

(iii) Coolant—A coolant removes the tremendous heat develops inside the nuclear reactor code. This energy is developed due to slow down of fast moving neutron water, stream, helium, CO_2, water, air, molten metals etc are used as a coolant.



(iv) Controlled Rods—To start and stop the nuclear reactor controlled rods are used due to large absorptional area those materials are used as a controlled rods. Whose area of cross-section is large.

Cadmium and Boron are most commonly used controlled rods.

(v) Radio-active protection Arrangement—For safe the life of Human beings from harmful radiations a dome shaped concrete wall of minimum thinkess 2m is net. So that it has no any harmful side effect to the common people. Normally nuclear is made in the place where poupulation is minimum.