Vivekanand College, Kolhapur. (Autonomous)
Department of Physics
Internal Examination Notice
2019-20

Date: 15/01/2020

All students of class B.Sc. I, B.Sc. II and B.Sc. III are hereby noticed that the second term internal evaluation examination is scheduled as per following time table.

Nature of question paper:

For B.Sc. I : Long answer question (Any one from given two questions) for 10 marks

Short answer question (Any two from given three questions) for 10 marks

For B.Sc. II : Long answer question (Any one from given two questions) for 10 marks

Short answer question (Any two from given three questions) for 10 marks

For B.Sc. II (Astro) : Long answer question (Any one from given two questions) for 10 marks

Short answer question (Any two from given three questions) for 10 marks

For B.Sc. III : Long answer question (Any one from given two questions) for 10 marks

Short answer question (Any two from given three questions) for 10 marks

Internal Evaluation Examination 2019-20.
SEM II, SEM IV and SEM VI
Time Table

Sr. No.	Class	Paper	Date	Time
1.	B.Sc. I	Paper II	27/01/2020	11:00 am to 12:00 pm
2.	B.Sc. II	Paper IV	27/01/2020	11:00 am to 12:00 pm
3.	B.Sc. II (Astrophysics)	Paper II	28/01/2020	11:00 am to 12:00 pm
4.	B.Sc. III	Paper VII (section I)	29/01/2020	11:00 am to 12:00 pm
		Paper VII (section II)		01:00 am to 02:00 pm
		Paper VIII (section I)	30/01/2020	11:00 am to 12:00 pm
		Paper VIII (section II)		01:00 am to 02:00 pm

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR - 416003

HOD

Head of the Department of Physics
Vivekanand College, Kolhapur

"*Dissemination of Education for Knowledge, Science and Culture*"
- *Shikshanmaharshi Dr. Bapuji Salunkhe*

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur

(Autonomous)

Department of Physics

Internal exam (2019-20)

B.Sc.III Sem VI

Attendance Sheet

Roll No.	Name Of The Student	Signature			
8001	Chougule Abhijeet Bajirao	Chougule	Chougule	Chougule	Chougule
8002	Dalvi tejas chetan	Dalvi	Dalvi	Dalvi	Dalvi
8003	Dinde Akash Sadashiv	Dinde	Dinde	Dinde	Dinde
8004	Gaikwad Suraj Dhananjay	Gaikwad	Gaikwad	Gaikwad	Gaikwad
8005	Ghosalkar Pranav Shankar	Ghosalkar	Ghosalkar	Ghosalkar	Ghosalkar
8006	Harshad Sitaram Katroot	Katroot	HKatroot	HKatroot	HKatroot
8007	Jadhav Pratiksha Harish	Jadhav	Jadhav	Jadhav	Jadhav
8008	Joshi Sourabh Kiran				
8009	Kamble Prasad Vilas	PK	PK	PK	PK
8010	Kumbhar Prathmesh Mallikarjun	P.M. Kumbhar	P.M. Kumbhar	P.M. Kumbhar	P.M. Kumbhar
8011	Kumbhar Jayvant Rajaram	JRK	JRK	JRK	JRK
8012	Manasi Vinayak Kulkarni	Mansi	Mansi	Mansi	Mansi
8013	Manasi Kahnderao Jagadale	Jagdale	Jagdale	Jagdale	Jagdale
8014	Nalavade Ankita Amar	Nalwade	Nalwade	Nalwade	Nalwade
8015	Paranjape Anish Shriram	AP	AP	AP	AP
8016	Patil Amruta Bhuigonda	A.Patil	A.Patil	A.Patil	A.Patil
8017	Patil Sujata Anandrao	Patil	Patil	Patil	Patil
8018	Patil Jeevan Maruti	JMPatil	JMPatil	JMPatil	JMPatil
8019	Patil Tejaswini Krishna	Patil	Patil	Patil	Patil
8020	Paul Jonathan Sanjay	Paul	Paul	Paul	Paul
8021	Potdar Aishwarya Sharad	Potdar	Potdar	Potdar	Potdar
8022	Radhika Baburao Shinde	Radhika	Radhika	Radhika	Radhika
8023	Ragini Jayprakash Benake	Benake	Benake	Benake	Benake
8024	Sandhya Sudhakar Dingane	Dingane	Dingane	Dingane	Dingane
8025	Sawant Rohit Ramchandra	Rohit	Rohit	Rohit	Rohit
8026	Sourabh Vijay Ghatage	VG	VG	VG	VG
8027	Sujit Dinkar Katale	S.P.K.	S.P.K.	S.P.K.	S.D.K
8028	Swaranjali Sanjay Shinde	Shinde	Shinde	Shinde	Shinde
8029	Swarupa Baburao Dhavale	Swarupa	Swarupa	Swarupa	Swarupa
8030	Tanvi Vikas Mohite	VT	VT	VT	VT
8031	Tibile Rohan Arjun	Rohan	Rohan	Rohan	Rohan
8032	Tushar Arvind Patil	पाटील	पाटील	पाटील	पाटील

VIVEKANAND COLLEGE KOLHAPUR ESTD JUNE 1964 (Autonomous)

8033	Yogita Vishnu Zirange	Yogita	Yogita	Yogita	Yogita

Internal Examinar.....................................

Vivekananda College Kolhapur (Autonomous).

Department of Physics: Internal examination2021-22

B.Sc. III Semester V

Subject: Electrodynamics and Electromagnetic Waves

Marks: 20 (Each question carry one mark) **Time : 20 min**

Q.1 Attempt any ONE **(10)**

1. Derive Poisson's equations and their physical significance
2. Derive Laplace's equations and their physical significance

Q.2 Attempt any TWO **(10)**

1. Discuss Laplace's equation in one dimension and its solution(Cartesian co-ordinate).
2. Derive an expression for motion of charged particle in uniform electric field.
3. Derive an expression for uniform magnetic field.

Name: Jeevan Maruti Patil

" ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार "
- शिक्षणमहर्षी डॉ. बापूजी साळुंखे

Signature of Supervisor

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE (Autonomous), KOLHAPUR

18/20

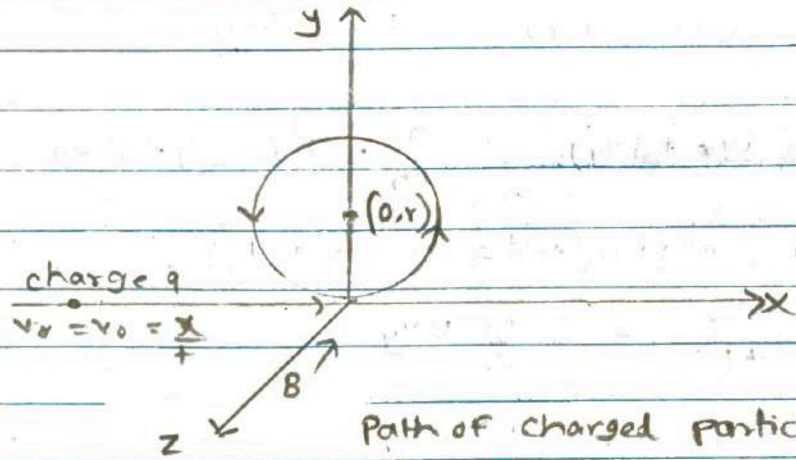
Class: BSc.III Div. ______ Roll No. 8018

Suppliment No. ______ Subject: Physics XX

Test / Tutorial No. Internal Exam

Q. Derive an expression for motion of charge particle in constant uniform magnetic field.

Let us consider a charge particle of charge q and mass m moving in constant magnetic field B.



Path of charged particle in uniform B field

10

Under the action of these magnetic field, the charge particle moves in a plane perpendicular to B i.e. in x-y plane. The force acting on a charged particle because of magnetic field B is.

$$F = q(v \times B) \quad \text{— (1)}$$

Let, i, j, k be the unit vectors along x, y, z axes respectively. ∴ if v_x and v_y are component of velocities of the charged particle along x and y directions respectively.

$$v = iv_x + jv_y \quad \text{— (2)}$$

According to Newton's second law of motion, force acting on the charged particle is

$$F = m \cdot \frac{dv}{dt} \quad \text{— (3)}$$

$$\therefore \frac{dv}{dt} = i\omega \, dt \quad \text{--- (9)}$$

Intergrating above eq.n for velocity & time

$$\int_{v_0}^{v} \frac{dv}{v} = \int_{0}^{t} i\omega \, dt$$

$$\therefore [\log v]_{v_0}^{v} = i\omega [t]_0^t$$

$$\therefore \log v - \log v_0 = i\omega t \quad \text{--- (10)}$$

$$\log \left(\frac{v}{v_0}\right) = i\omega t$$

$$\therefore \frac{v}{v_0} = e^{i\omega t}$$

$$\therefore v = v_0 e^{i\omega t}$$

But $v = v_x + i v_y$

and $e^{i\omega t} = \cos\omega t + i\sin\omega t$

equation becomes

$$(v_x + i v_y) = v_0 (\cos\omega t + i\sin\omega t) \quad \text{--- (11)}$$

comparing real & imaginary parts on both sides

$$v_x = v_0 \cos\omega t \quad \text{--- (12)}$$

$$v_y = v_0 \sin\omega t \quad \text{--- (13)}$$

squaring & adding equation

$$v_x^2 + v_y^2 = v_0^2 \cos^2\omega t + v_0^2 \sin^2\omega t$$

$$v_x^2 + v_y^2 = v_0^2$$

$$\sqrt{v_x^2 + v_y^2} = v_0$$

$$\therefore v = v_0$$

Further,

$$v_x = dx/dt$$

$$\therefore \frac{dx}{dt} = v_0 \cos\omega t$$

$$dx = v_0 \cos\omega t \cdot dt$$

Integrate above equations

8

$$\int_0^x dx = \int_0^t v_0 \cos\omega t \cdot dt$$

$\therefore$ $$x = \frac{v_0}{\omega} \sin\omega t + k \quad \text{—— (14)}$$

k is constant of intergration, At $t=0$, $x=0$ and $k=0$

$$v_y = dy/dt$$

$\therefore$ $$dy/dt = v_0 \sin\omega t$$

$\therefore$ $$dy = v_0 \sin\omega t \cdot dt$$

Integrate above eqn

$$\int_0^y dy = \int_0^t v_0 \sin\omega t$$

$\therefore$ $$y = -\frac{v_0}{\omega} \cos\omega t + k \quad \text{—— (15)}$$

At $t=0$, $y=0$ then

$$0 = -v_0/\omega + k$$

$\therefore$ $$k = v_0/\omega$$

Hence equation (15) changes to

$$y = -\frac{v_0}{\omega} \cos t\,\omega t + v_0$$

$\therefore$ $$y = \frac{v_0}{\omega} - \frac{v_0}{\omega} \cos\omega t \quad \text{—— (16)}$$

But $\frac{v_0}{\omega} = r$ = radius of path taken by charged particle

$\therefore$ $$x = r\sin\omega t \quad \text{—— (17)}$$

$$y = r - r\cos\omega t \quad \text{—— (18)}$$

$$y - r = -r\cos\omega t \quad \text{—— (19)}$$

Squaring and adding eq (18) and (19)

$$x^2 = (y-r)^2 = r^2\sin^2\omega t + r^2\cos^2\omega t$$

$$x^2 + (y-r)^2 = r^2 \quad \text{—— (20)}$$

this eqn is equation of circle with centre (0, r) radius r.

$\therefore$ Thus motion of charged particle in B field is circular

" ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार "
- शिक्षणमहर्षी डॉ. बापूजी साळुंखे

Signature of Supervisor

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE (Autonomous), KOLHAPUR

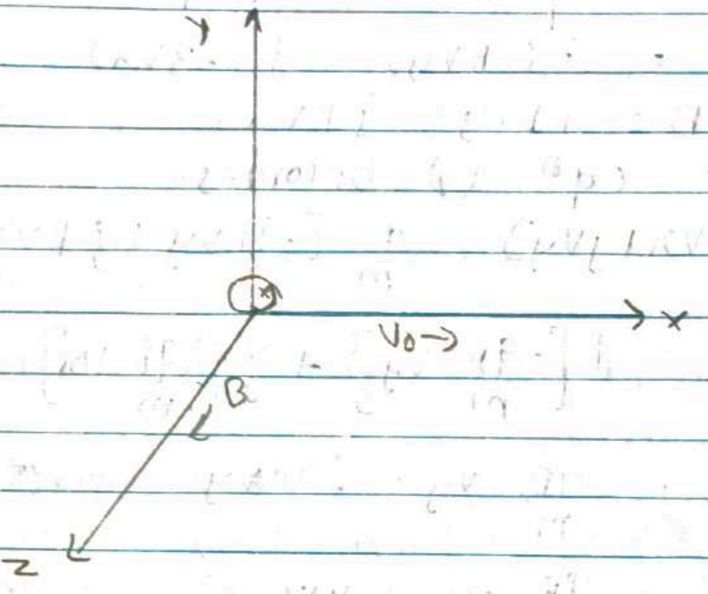
15/20

Class B.Sc - III Div. Roll No. 8019

Suppliment No. Subject physics

Test / Tutorial No. Internal Exam - 1. ~~Surprise~~

Ans - 1 The motion of a charged particle in a constant uniform magnetic field.



Consider charge particle q of mass a moving with velocity v_0 along the x axis

10

Let it enters in a constant uniform magnetic field B directed along -ve 'z' direction. Due to magnetic field particle experience magnetic force Fm & it is given by.

$$Fm = q(v \times B) \quad —①$$

Where v = velocity of particle in M.F.

Under the act° of magnetic force fm the particle moves in a direction ⊥st to B & v. i.e the particle moves in x, y plane with velocity 'v' & it is given by

$v = iv_x + jv_y$ — ②

Acc to Newton's 2nd low we have,

$$F_m = ma = \frac{m\,dv}{dt} \quad — ③$$

We have $v = iv_x + jv_y$

$B = -kB$

$$\therefore v \times B = \begin{vmatrix} i & j & k \\ v_x & v_y & 0 \\ 0 & 0 & B \end{vmatrix}$$

$$= i(-Bv_y) - j(-Bv_x)$$

$$v \times B = iBv_y + jBv_x$$

heance eq^n ② becomes.

$$\frac{d}{dt}[iv_x + jv_y] = \frac{q}{m}[-iBv_y + jBv_x]$$

$$= i\left[-\frac{qB}{m}v_y\right] + j\left[\frac{qB}{m}v_x\right]$$

$$\frac{dv_x}{dt} = -\frac{qB}{m}v_y = -\omega v_y \quad — ⑤$$

$$\frac{dv_y}{dt} = \frac{qB}{m}v_x = \omega v_x \quad — ⑥$$

where $\omega = \frac{qB}{m}$

multiplying eq^n ⑥ by imaginary no. ① & adding in eq^n ⑤

$$\frac{dv_x}{dt} + i\frac{dv_y}{dt} = -\omega v_y + i\omega v_x$$

$$\frac{d}{dt}[v_x + iv_y] = i\omega[v_x + iv_y]$$

put $v_x + iv_y = V$ — ⑦

we get.

eq^n ⑦ is a $diff^n$ eq^n of the I^{st} order.

$$\frac{dv}{v} = i\omega dt.$$

Integrating at both side.

$$\int_{v_0}^{v} \frac{dv}{v} = \int i\omega\, dt$$

$$[\log v]_{v_0}^{v} = i\omega t.$$

$$\log \frac{v}{v_0} = i\omega t$$

$$\frac{v}{v_0} = e^{i\omega t}.$$

$$v = ve^{i\omega t}.$$

substitating value of v, we get,

$$v_x + iv_y = v_0 e^{i\omega t}.$$

$$v_x + iv_y = v_0 [\cos\omega t + i\sin\omega t]$$

$$v_x + iv_y = v_0 \cos\omega t + iv_0 \sin\omega t.$$

5

Equating real terms & imaginary terms.

$$v_x = v_0 \cos\omega t.$$

$$v_y = v_0 \sin\omega t.$$

Consider

$$v_x = v_0 \cos\omega t.$$

$$\frac{dx}{dt} = v_0 \cos\omega t$$

$$dx = v_0 \cos\omega t\, dt$$

Integrating at both sides.

$$\int dx = v_0 \int_0 \cos\omega t\, dt.$$

$$x = v_0 \frac{\sin\omega t}{\omega t}.$$

Now consider

$v_y = v_0 \sin \omega t$

$\frac{dy}{dt} = v_0 \sin \omega t.$

$dy = v_0 \sin \omega t \, dt.$

on integrating

$\int dy = v_0 \int_0^{\omega} \sin \omega t \, dt.$

$y = \frac{v_0}{\omega} [\cos \omega t]_0^1 = \frac{v_0}{\omega} [\cos \omega t - 1]$

$y = -r (\cos \omega t - r)$

$y = -r - r \cos \omega t$ — (8)

$y - r = -r \cos \omega t$ — (9)

squaring & adding eq^n (8) & (9) we get.

$x^2 + (y-r)^2 = r^2$

Above eq^n is eq^n of circle which given trajectory of particle is circular.

Vivekananda College Kolhapur (Autonomous).
Department of Physics: Internal examination 2019-20

B.Sc. III Semester V

Subject: Energy Studies and Materials Science

Marks: 20 (Each question carry one mark) Time : 20 min

Q.1 Attempt any ONE **(10)**

1. Discuss briefly wind energy, wind energy chains, wind energy quantum
2. Write a note on Efficiency factor of wind turbine(P-H graph).

Q.2 Attempt any TWO **(10)**

3. Write a note on Classification of energy resources.
4. What are the types of types of a wind turbine generator unit.
5. Define the factors : a) wind energy chains, b) wind energy quantum, c) wind power density, d) power of wind turbine for a given incoming wind velocity

॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

34050

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

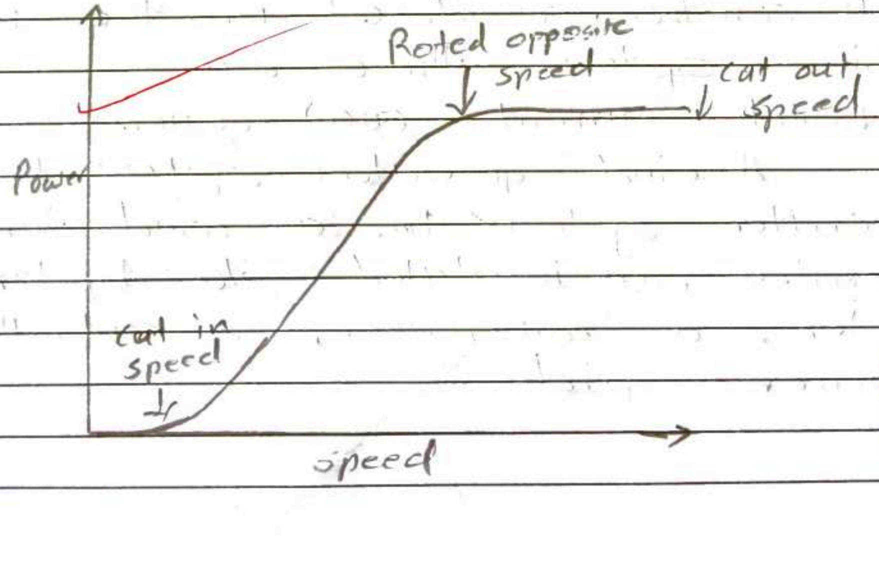
SUPPLIMENT

15/20

Suppliment No. :	Signature of Supervisor
Roll No. : 8525	Subject : (Energy studies and material science)
Class : B.Sc. III, sem - V	Test / Tutorial No. : Internal exam
	Div. :

Q.1

2) The power output of wind turbine depends on where it is located, as well as the physical characteristics of the turbine itself. It is highly unlikely that the wind speed will be steady in any location, and ∴ the output will vary in line with the speed at any one time. This is where a wind turbine power curve can help to estimate current and near future output



At very low wind speeds, there is insufficient torque exerted by the wind on the turbine blades to make them rotate. However, as the speed increases, the wind turbine will region to rotate and generates electrical power.

The speed at which the turbine first start to rotate and generate power is called the cut-in-speed, and is typically betn 3 and 4 meteres per second.

The available power in a stream of wind of the same cross sectional area as the wind turbine can easily be shown to be

$\frac{1}{2} \rho v^3 \frac{\pi d^2}{4}$

10

If the wind speed v is in meter per second, the density ρ is in kilograms per cubic meter and the rotor diameter d is in meters then the available power in watts.

Q-2

2) There are four types of wind turbines generator which can be considered for the various wind turbine systems those are

1. Direct current (DC) generators

A wind generator system has a wind generator system has a wind turbine, a DC generator, an insulated gate bipolar trasistor inverter, a transformer, a controller, and a power grid

2. Ac synchronous Generator :-

Ac synchronous wind turbine generators can take constant or Dc excitation from either permanent magnets of electromagnets.

08 3. Switched Reluctance wind Turbine Generator

switched relutance wind turbine generators have features such as strong rotor and stator.

॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥

– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

34046

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Suppliment No. :

19/20

Subject : Energy Studies and Material science

Roll No. : 8513

Test / Tutorial No. : Internal Exam

Class : B.Sc III, Sem-V

Div. :

Q.2)

3) ⓐ Wind energy chains - The wind power value chain incorporates five main stages: materials, components manufacture, logistics, development and operations.

ⓑ Wind energy Quantum - Wind energy is a form of Solar energy, meaning that it originates from the sun. The Sun heats the atmosphere unevenly so that the temperature varies at different places.

ⓒ Wind Power Density - Wind power density is a quantitive measure of wind energy available at any location. It is the mean annual power available per square meter of swept area of a turbine.

05

ⓓ Power of wind turbine - Wind turbines convert the kinetic energy in the wind into mechanical power. The mechanical power can be used for specific tasks.

Q.2)

2) There are four types of wind turbines generator which can be considered for the various wind turbine systems those are:

1. Direct Current (DC) generators-

A wind generator system has a wind turbine, a DC generator, an insulated gate bipolar transistor inverter, a transformer, a controller, and a power grid

2. AC Synchronous Generator -

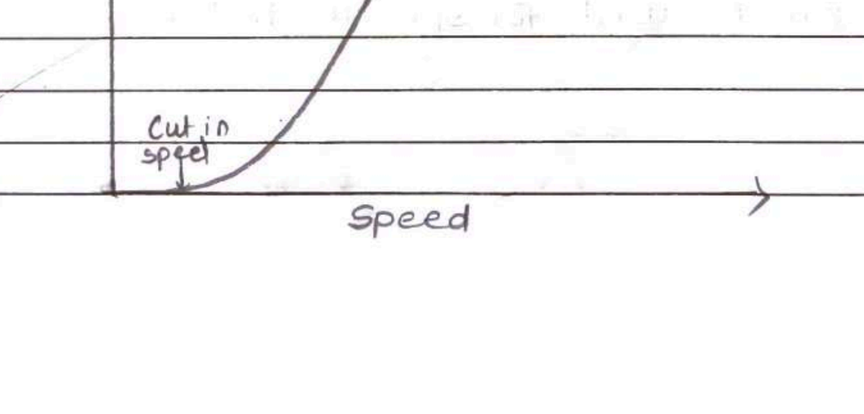
AC synchronous wind turbine generators can take constant or DC excitations from either permanent magnets or electromagnets.

3. Switched Reluctance Wind Turbine Generator -

Switched reluctance wind turbine generators have feature such as strong rotor and stator.

Q.1)

2) The power output of a wind turbine depends on where it is located, as well as the physical characteristics of the turbine it self. It is highly unlikely that the wind speed will be steady in any location, and therefore the output will vary in line with the speed at any one time. This is where a wind turbine power curve can help to estimate current and near future output.



At very low wind speeds, there is insufficient torque exerted by the wind on the turbine blades to make them rotate. However, as the speed increases, the wind turbine will region to rotate and generates electrical power.

The speed at which the turbine first starts to rotate and generate power is called the cut-in-speed. and is typically bet^n 3 and 4 meters per second.

The available power in a stream of wind of the same cross sectional area as the wind turbine can easily be shown to be : $\frac{1}{2} \rho U^3 \frac{\pi d^2}{4}$

If the wind speed U is in meters per second, the density ρ is in kilograms per cubic meter and the rotor diameter d is in meters then the available power in watts.

Vivekananda College Kolhapur (Autonomous).
Department of Physics: Internal examination2019-20
B.Sc. III Semester VI
Subject: Nuclear and Particle Physics

Marks: 20 (Each question carry one mark) **Time : 20 min**

Q.1 Attempt any ONE **(10)**

1. Explain the Cyclotron- construction, working, theory- expression for energy of cyclotron and its limitations
2. Explain the Synchro-cyclotron construction, working and its advantages, disadvantages.

Q.2 Attempt any TWO **(10)**

1. Discuss the principle of Principle of phase stable orbits
2. Derive the expression for Betatron expression of energy gain.
3. Write a note on Need of accelerators.

॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

34024

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

15/20

Signature of Supervisor:

Suppliment No. :

Roll No. : 8509

Class : BSC III Sem V

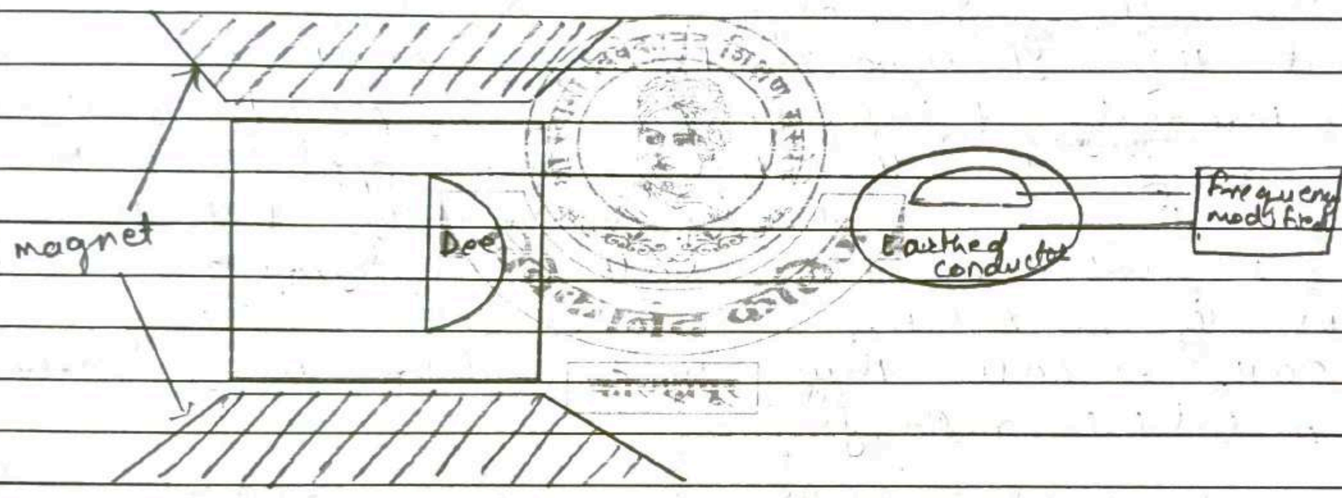
Subject : Nuclear and Particle Physics.

Test / Tutorial No. : Internal Exam

Div. :

Q1)

1)



Synchrocyclotron is basically a cyclotron with some modification viz,

1) The size of the dees is fairly large as maximum obtainable energy is very large & hence the pole-piece diameters are also very large

2) Instead of simple radio frequency oscillator, the alternating voltage is obtained from a frequency modulated supply

In Berkely Synchrocyclotron, the modulated frequency is varied from 12.6 MHz to 9.0 MHz.

3) Only one dee is used with an earthed conductor on the opposite side of opening of the dee.

Working :- To impart energy to the particle, the frequency of an alternating voltage between dees is decreased when the particle goes into a phase stable orbit characterised by a large radius with gain energy.
But this decrease in frequency must be done continuously & very slowly as compared to the frequency of alternating voltage applied to the dee's decreases slowly & continuously, but the peak value of the voltage remains the same usually, modulation is done at 50 Hz or 60 Hz Thus, synchrocyclotron uses a frequency modulated radio frequency.

Advantages of synchrocyclotron

1) As it is based on the principal of phase stable orbit the relativistic mass increase is taken care of & therefore there is no need to restrict the no of revolutions & hence the potential difference required between the dees may be very small.

2) Large electric fields in the gap required for focusing and accelerating the particles in cyclotron are number demanded so, usually only one dee is

used This ample space is made available in the evacualeted steel tank.

3) In Berkely 184 inch synchrocyclotron, the proton energies upto 300MeV have been relised.

10

Q2.

1) The principal of principle of phase stable orbit.

Consider a particle of relativistic mass

$$m = m_0\left(1 - \frac{v^2}{c^2}\right)^{-1/2},$$

and charge e, moving in an orbit of radius r, under the influence of magnetic field B

$$\frac{mv^2}{r} = Bev \quad \text{—— ①}$$

Angular velocity $\omega = \frac{v}{r} = \frac{Be}{m}$

The angular velocity $\left(\omega = \frac{2\pi}{T}\right)$ will be constant for particle with constant mass m, which is the principal of cyclotron.

$$\omega = \frac{Bec^2}{mc^2} = \frac{Bec^2}{m_0c^2 + E_K} \quad \text{—— ②}$$

where m_0c^2 is rest mass energy & E_K is kinetic energy of the particle.

Thus the angular velocity of the particle in a constant magnetic field, decreases with increase in the kinetic energy & hence the phase relationship required for cyclotron principal will be upset. However a particle with a definite kinetic energy Ek will move in a stable orbit with constant angular velocity w
which is also the angular frequency of the alternating voltage between the dees.
such an orbit where phase - stability is maintained

Now it can be seen that the particle with a Specific energy can be maintained in a phase - stable orbit, if every Ek will move in a stable orbit with constant angular velocity w which is also the angular frequency of it, when the instantaneous potential difference across the dees is zero & about to become decelerating.

5

॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥
– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

34023

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

15/20

Signature of Supervisor	
Suppliment No. :	Subject : Nuclear and Particle physics
Roll No. : 8522	Test / Tutorial No. : Internal
Class : B.Sc. Sem V	Div. :

Synchrocyclotron –

Construction –

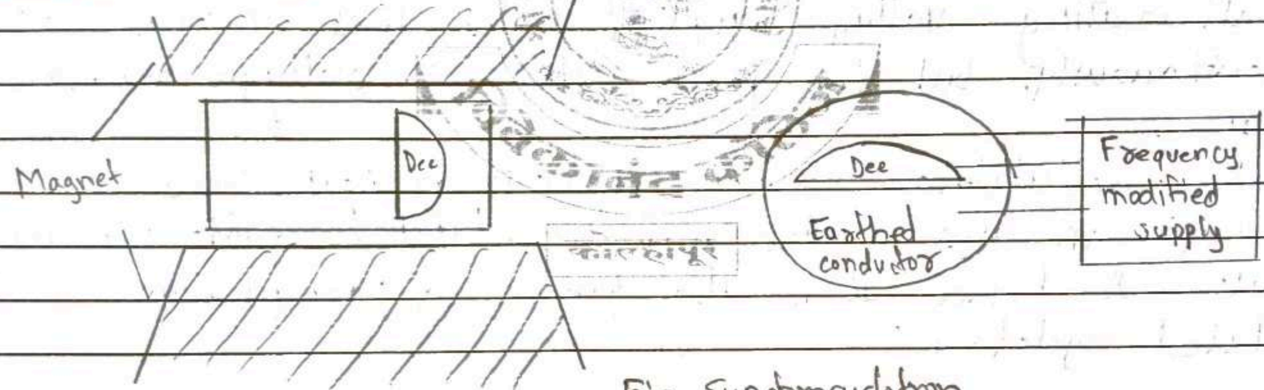


Fig. Synchrocyclotron

Synchrocyclotron is basically a cyclotron with some modifications viz.

1) The size of dees is fairly large as maximum obtainable energy is very large & hence the pole-piece diameters are also very large. Therefore, huge magnets weighing several tonnes are used.

2) Instead of simple radio frequency oscillator, the alternating voltage is obtained from a frequency modulated supply. In Berkeley synchrocyclotron, the modulated frequency is varied from 26 MHz to 9.0 MHz at a modulation frequency

of 120Hz.

5) Only one dee is used with an earthed conductor on the opposite side of opening of the dee as shown in the above fig.

Working-

① To impart energy to the particle, the frequency of an alternatively voltage between dees is decreased, when the particle goes into phase stable-orbit characterised by a large radius with gain in energy.

② But this decrease in frequency must be done continuously & very slowly as compared to frequency of alternating potential difference across dees. This is achieved by using a frequency modulated supply where in frequency of the alternating voltage applied to the dees decrease slowly & continuously but the peak value of voltage remains the same.

③ Usually modulation is done at 50 Hz or 60Hz. Thus synchrocyclotron uses a frequency modulated radio frequency oscillator & hence it is also known as 'frequency modulated cyclotron'.

Advantages

① As it is based on principle of phase-stable orbits, the relativistic mass increase is taken care of and therefore there is no need to restrict the no. of revolutions & hence the potential difference required bet^n dees may be very small. Usually it is about 15kV at peak of alternating voltage.

② Large electric fields in gap required for focusing and accelerating particles in cyclotron are no longer demand. So usually only 1 dee is used. Thus ample space is ma available in evacuated steel tank for setting different targets or other apparatus.

(3) In Berkeley 184 inch synchrocyclotron the proton energies upto 300 MeV have been released.

Disadvantages -

(1) It can't be used to accelerate electron.

2.4] Phase - stable Orbit Condition -

(1) Consider a particle of relativistic mass $m = M_0 \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}$ and charge e, moving in an orbit of radius r under the influence of magnetic field B.

$$\frac{mv^2}{r} = BeV \quad \text{--- (1)}$$

$$\text{Angular velocity } \omega = \frac{V}{r} = \frac{Be}{m}$$

(2) The angular velocity $\left(\omega = \frac{2\pi}{T}\right)$ will be constant for particles with constant mass m, which is the principle of cyclotron. But when m increases relativistically then.

$$\omega = \frac{Bec^2}{mc^2} = \frac{BeC^2}{m_0c^2 + E_k} \quad \text{--- (2)}$$

(3) When m_0c^2 is rest mass energy & E_k is kinetic energy of particle.

(4) Thus, the angular velocity of particle in constant magnetic field decreases with increase in kinetic energy & hence phase relationship required for cyclotron principle will be upset.

However, a particle with a definite kinetic energy E_k will move in stable orbit with constant angular velocity ω which is also angular frequency of alternating voltage bet^{n} dees.

⑥ Such an orbit where phase stability is maintained is called a phase-stable-orbit.

⑦ Now it can be seen that the particle with specific ene: can be maintained in phase-stable-orbit if every time it crosses the gap between dees when the instantaneous potential difference across the dees is zero and about to become decelerating.

5

Vivekananda College Kolhapur (Autonomous).
Department of Physics: Internal examination2021-22
B.Sc. III Semester V
Subject: Solid State Physics

Marks: 20 (Each question carry one mark) **Time : 20 min**

Q.1 Attempt any ONE **(10)**

1. Discuss Reciprocal lattice, Properties of reciprocal lattice.
2. Derive Bragg's law in reciprocal Lattice (Ewald's construction).

Q.2 Attempt any TWO **(10)**

1. Define Powder method of X- ray diffraction.
2. Write a note on Miller indices
3. Derive packing fraction of HCP structure.

PRN No. 2015015500159146

कोल्हापूर

VIVEKANAND COLLEGE, KOLHAPUR

Jr. Supervisor's Sign :

Students Sign : P.V.Manwadi

Seat No. 8520

Seat No. in words

Center

Information to be filled by Student

(विद्यार्थ्याने भरावयाचा रकाना)

Day and Date : Tuesday, 23-1-2018

Language of Answer : English

Examination : Internal Exam

Question Paper Code No : -

Subject : Physics

Paper No: XVI

Section : -

Q. No.	Examiner Marks	Moderator Marks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Total	25/25	
Signature		

Q.C. - O.K.

IMPORTANT

As per Maharashtra Act No. XXXI of 1982 (7 & 8) whoever is found in or near an examination hall by the invigilator or any other person appointed to supervise the conduct of the examination, copying answers to the question paper set at the examination, from any book, notes or answer papers of other candidates, of appearing at the examination for any other candidates or using any other unfair means, shall, on conviction, be punished with imprisonment for a term which may extend to six months, or with fine which may extend to five hundred rupees or with both.

Whoever abets any offence punishable under this Act shall be punishable with the punishment provided for the offence.

सूचना : विद्यापीठ नियमानुसार जो कोणी परिक्षा हॉलजवळ किंवा हॉलमध्ये पर्यवेक्षकांना किंवा परीक्षेसाठी नेमलेल्या कर्मचाऱ्यांना उत्तरपत्रिकेत पुस्तक नोट्स किंवा अन्य विद्यार्थ्यांच्या उत्तरपत्रिकेतून नक्कल करताना आढळून येईल किंवा जवळ परीक्षा गैरव्यवहारासाठी वापरता येईल असे आक्षेपार्ह साहित्य बाळगत असेल तर सदरची बाब परीक्षा प्रमाद मानून संबंधित व्यक्ति शिक्षेस पात्र राहील.

Q. No.				TOTAL				TOTAL
Marks								

Que. 1.

i) a) 12

ii) a) 3/2

iii) a) (6 4 3)

iv) c) reflection

v) b) inversely proportional to volume of unit cell of direct lattice

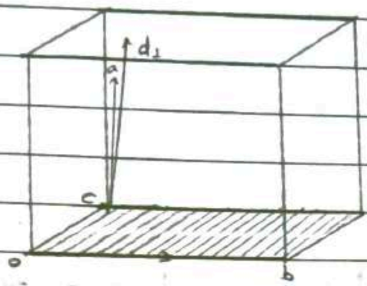
5

Q. No.				TOTAL				TOTAL
Marks								

Q. No.

Que. 2.

i) Relation between direct lattice and reciprocal lattice :-



The relation between direct lattice & reciprocal lattice can be calculated.
Let, V be the volume of unit cell.

Volume = Area (shaded region) x height

volume = area x d_1

$\therefore d_1 = \frac{\text{volume}}{\text{area}}$

$\therefore \frac{1}{d_1} = \frac{\text{area}}{\text{volume}}$

$\therefore \frac{\vec{n}}{d_1} = \frac{\vec{a}}{\vec{a}\cdot(\vec{b}\times\vec{c})} \times \vec{\sigma}_{100}$

As $\vec{a}\cdot(\vec{b}\times\vec{c})$ be the volume.

Q. No.

$$\therefore \sigma_{100} = \frac{\vec{b} \times \vec{c}}{\vec{a} \cdot (\vec{b} \times \vec{c})}$$

Reciprocal lattices are given by σ_{100}, σ_{010} & σ_{001} as they are denoted as a^*, b^* & c^*.

$$\therefore a^* = \frac{\vec{b} \times \vec{c}}{\vec{a} (\vec{b} \times \vec{c})}$$

IIIly,

$$b^* = \frac{\vec{c} \times \vec{a}}{\vec{a} \cdot (\vec{b} \times \vec{c})}$$

$$c^* = \frac{\vec{a} \times \vec{b}}{\vec{a} \cdot (\vec{b} \times \vec{c})}$$

This is the relation between direct lattice & reciprocal lattice.

Properties of reciprocal lattices :-

i) The reciprocal of reciprocal lattice is a direct lattice :-

The reciprocal lattice a^* is given by,

$$a^* = \frac{\vec{b} \times \vec{c}}{\vec{a} \cdot (\vec{b} \times \vec{c})}$$

we have to show,

$$(a^*)^* = a$$

Q. No.				TOTAL				TOTAL
Marks								

Q. No.

$$\therefore (a^*)^* = \frac{b^* \times c^*}{a^* \cdot (b^* \times c^*)} \quad \ldots (1)$$

We know that, $a \cdot a^* = 1$

Multiply eq^n (1) by $a \cdot a^*$

$$\therefore (a^*)^* = a \cdot a^* \frac{b^* \times c^*}{a^* \cdot (b^* \times c^*)}$$

$$= a \cdot \frac{a^* \cdot (b^* \times c^*)}{a^* \cdot (b^* \times c^*)}$$

$$(a^*)^* = a$$

hence we proved this.

ii) The volume of unit cell in reciprocal lattice is the reciprocal of volume of unit cell in direct lattice :

To show : $a^* \cdot (b^* \times c^*) = \frac{1}{a \cdot (b \times c)}$

Proof :-

$$a^* \cdot (b^* \times c^*) = \left\{\frac{b \times c}{a \cdot (b \times c)}\right\} \left\{\frac{c \times a}{a \cdot (b \times c)}\right\}$$

$$\left\{\frac{a \times b}{a \cdot (b \times c)}\right\}$$

Q. No.

$$= \frac{1}{[a.(b\times c)]^3} . (b\times c)[(c\times a)(a\times b)]$$

$$= \frac{1}{[a.(b\times c)]^3} . (b\times c) [c(c\times a).a - a(a\times b)c]$$

we know that,

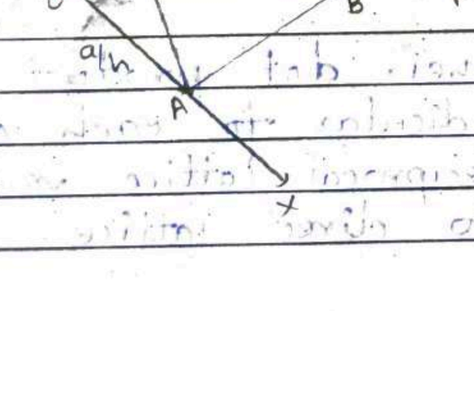
$$(c\times a.)a = 0$$

$$\therefore a^*.(b^* \times c^*) = \frac{1}{[a.(b\times c)]^3}[a.(b\times c)]^2$$

$$\therefore a^*.(b^* \times c^*) = \frac{1}{a.(b\times c)}$$

That is the proof.

iii) Every reciprocal lattice vector is perpendicular to direct lattice.



Q. No.				TOTAL					TOTAL
Marks									

Q. No.

The intercept on x-axis is,

$$OA = \frac{\vec{a}}{h}$$

The intercept on Y-axis is,

$$OB = \frac{\vec{b}}{K}$$

The intercept on z-axis is,

$$OC = \frac{\vec{c}}{l}$$

From diagram,

$$\frac{\vec{b}}{K} + \vec{B} = \frac{\vec{a}}{h}$$

$$\vec{B} = \frac{\vec{a}}{h} - \frac{\vec{b}}{K}$$

$\vec{B} \cdot \vec{\sigma}_{hkl}$ be the scalar product.

$$\vec{B} \cdot \vec{\sigma}_{hkl} = \left(\frac{\vec{a}}{h} - \frac{\vec{b}}{K}\right) \cdot (ha^* + Kb^* + lc^*)$$

$$= 1 - 1$$

$$= 0$$

and this scalar product value is zero.

similarly,

$$\vec{A} \cdot \vec{\sigma}_{hkl} = 0$$

hence as their dot product is zero, that are perpendicular to each other.

i.e. Every reciprocal lattice vector is perpendicular to direct lattice.

10

PRN - 2015010055714255

Jr. Supervisor's Sign :
Students Sign : Patil
Seat No. 8530
Seat No. in words Eight Eight Three Zero
Center

VIVEKANAND COLLEGE, KOLHAPUR

Information to be filled by Student
(विद्यार्थ्याने भरावयाचा रकाना)

Day and Date : 23 - 1 - 018

Language of Answer : English

Examination : B. Sc. III, Internal

Question Paper Code No :

Subject : Physics

Paper No:

Section :

Q. No.	Examiner Marks	Moderator Marks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Total	21/25	
Signature		

Q.C. - O.K.

IMPORTANT

As per Maharashtra Act No. XXXI of 1982 (7 & 8) whoever is found in or near an examination hall by the invigilator or any other person appointed to supervise the conduct of the examination, copying answers to the question paper set at the examination, from any book, notes or answer papers of other candidates, of appearing at the examination for any other candidates or using any other unfair means, shall, on conviction, be punished with imprisonment for a term which may extend to six months, or with fine which may extend to five hundred rupees or with both.

Whoever abets any offence punishable under this Act shall be punishable with the punishment provided for the offence.

सूचना : विद्यापीठ नियमानुसार जो कोणी परिक्षा हॉलजवळ किंवा हॉलमध्ये पर्यवेक्षकांना किंवा परीक्षेसाठी नेमलेल्या कर्मचाऱ्यांना उत्तरपत्रिका पुस्तक नोट्स किंवा अन्य विद्यार्थ्यांच्या उत्तरपत्रिकेतून नक्कल करताना आढळून येईल किंवा जवळ परीक्षा गैरव्यवहारासाठी वापरता येईल असे अयोग्य साहित्य बाळगत असेल तर सदरची बाब परीक्षा प्रमाद मानून संबंधित व्यक्ति शिक्षेस पात्र राहील.

Q. No.				TOTAL				TOTAL
Marks								

Q. No. 1

1) The co-ordination no. of FCC lattice is 12

2) The atomic radius for simple cubic lattice is a/2

3) The Miller indices of a plane which cuts the intercept of 2, 3 & 4 unit along the three axes respectively are, 6 4 3

4) Diffraction of X-rays from the crystal is the phenomenon of ~~refraction~~ reflection.

5) The volume of unit cell of reciprocal lattice is inversely proportional to volume of unit cell of direct lattice.

05

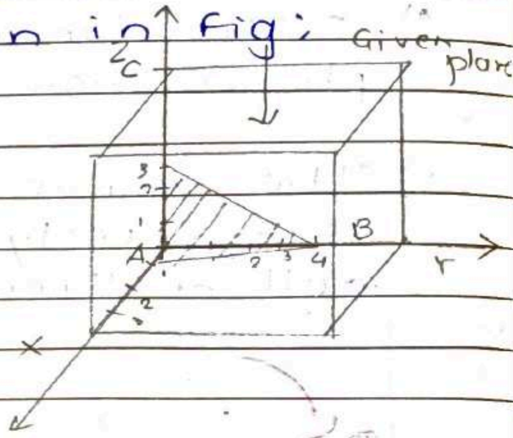
Q. No.				TOTAL				TOTAL
Marks								

Q. No. 2)

2) In a crystal plane are difine by giving their orientation without giving position in space with reference to the direction of basis vector, plane has particular orientation, which may define by any three points. of a plane, provided the points are not collinear

Consider a plane having plane ABC intercept one axial unit on X axis, four axial unit on Y axis & three axial unit on the z axis. shown in fig:

The numerical parameter of the faces or plane are 4, 2, 3 these parameter taken as reciprocal of number These parameter are called as Miller Indices.

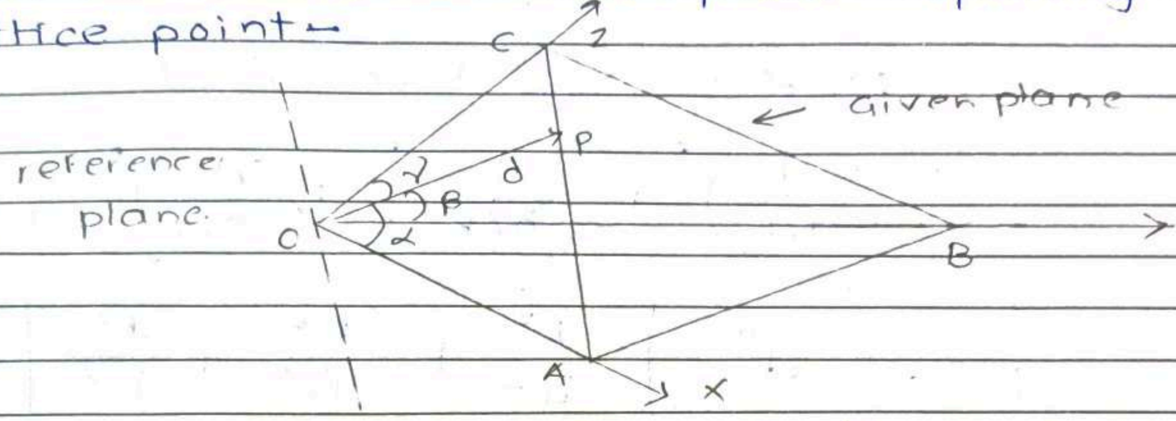


Axial length	4 A	8 A	3A
Intercept	1A	4 A	3A
Fractional intercept	$\frac{1}{4}$	$\frac{8}{4}$	$\frac{3}{3}$
reciprocal (Miller Indices)	4	2	1

Miller indices of ABC plane (4,2,1) denoted by hkl in paranthesis is

(hkl) = (4,2,1)

Realation in terms of interplaner spacing and lattice point :-



Consider the axis XYZ mutually perpendicullar to each other.

Consider a reference plane passes through origin & next plane ABC cuts on the intercept a/h on x axis., b/k on Y axis and c/l on z axis.

let d be perpendicular distance betn reference plane & given plane.

let (h,k,l) be miller indices of given plane. let α be the angle betn normal and OA, β be angle betn normal & plane OB & γ be angle betn normal & plane OC.

let cos α, cos β, cos γ be the direction angle ~~betn~~ of normal plane

by geometry in Δ AOBC,

$$\cos\alpha = \frac{d}{a/h}$$

$$\cos\beta = \frac{d}{b/k}$$

$$\cos\gamma = \frac{d}{c/l}$$

Q. No.				TOTAL				TOTAL
Marks								

Q. No.

by using the property of triangle, trigonometry

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

$$\therefore \left(\frac{d}{a/h}\right)^2 + \left(\frac{d}{b/k}\right)^2 + \left(\frac{d}{c/l}\right)^2 = 1$$

$$\therefore d^2\left[\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}\right] =$$

$$\therefore d^2 = \frac{1}{\left(\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}\right)}$$

$$\therefore \boxed{d = \frac{1}{\sqrt{\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}}}}$$

special case -

For cubic system,

$a = b = c$

$$\therefore d = \frac{1}{\sqrt{\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}}}$$

$$d = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

VIVEKANAND COLLEGE, KOLHAPUR

Jr. Supervisor's Sign :	
Students Sign :	RR
Seat No.	8506
Seat No. in words	
Center	

Information to be filled by Student
(विद्यार्थ्यांनी भरावयाचा रकाना)

Day and Date : 23/1/2018

Language of Answer : English

Examination : BSC III, Internal

Question Paper Code No :

Subject : Physics

Paper No: Paper XVI

Section :

Q. No.	Examiner Marks	Moderator Marks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Total	22/25	
Signature		

Q.C. - O.K.

IMPORTANT

As per Maharashtra Act No. XXXI of 1982 (7 & 8) whoever is found in or near an examination hall by the invigilator or any other person appointed to supervise the conduct of the examination, copying answers to the question paper set at the examination, from any book, notes or answer papers of other candidates, of appearing at the examination for any other candidates or using any other unfair means, shall, on conviction, be punished with imprisonment for a term which may extend to six months, or with fine which may extend to five hundred rupees or with both.

Whoever abets any offence punishable under this Act shall be punishable with the punishment provided for the offence.

सूचना : विद्यापीठ नियमानुसार जो कोणी परिक्षा हॉलजवळ किंवा हॉलमध्ये पर्यवेक्षकांना किंवा परीक्षेसाठी नेमलेल्या कर्मचाऱ्यांना छापील पुस्तके नोट्स किंवा अन्य विद्यार्थ्यांच्या उत्तरपत्रिकेतून नक्कल करताना आढळून येईल किंवा जवळ परीक्षा गैरव्यवहारासाठी वापरता येईल असे साहित्य बाळगत असेल तर सदरची बाब परीक्षा प्रमाद मानून संबंधित व्यक्ति शिक्षेस पात्र राहील.

VIVEKANAND COLLEGE KOLHAPUR ESTD JUNE 1964 (Autonomous)

Q. No.				TOTAL				TOTAL
Marks								

Q. No.

Q.1

i) a) 12

ii) a) a/2

iii) ~~a) (6, 4, 3)~~ a) (6 4 3)

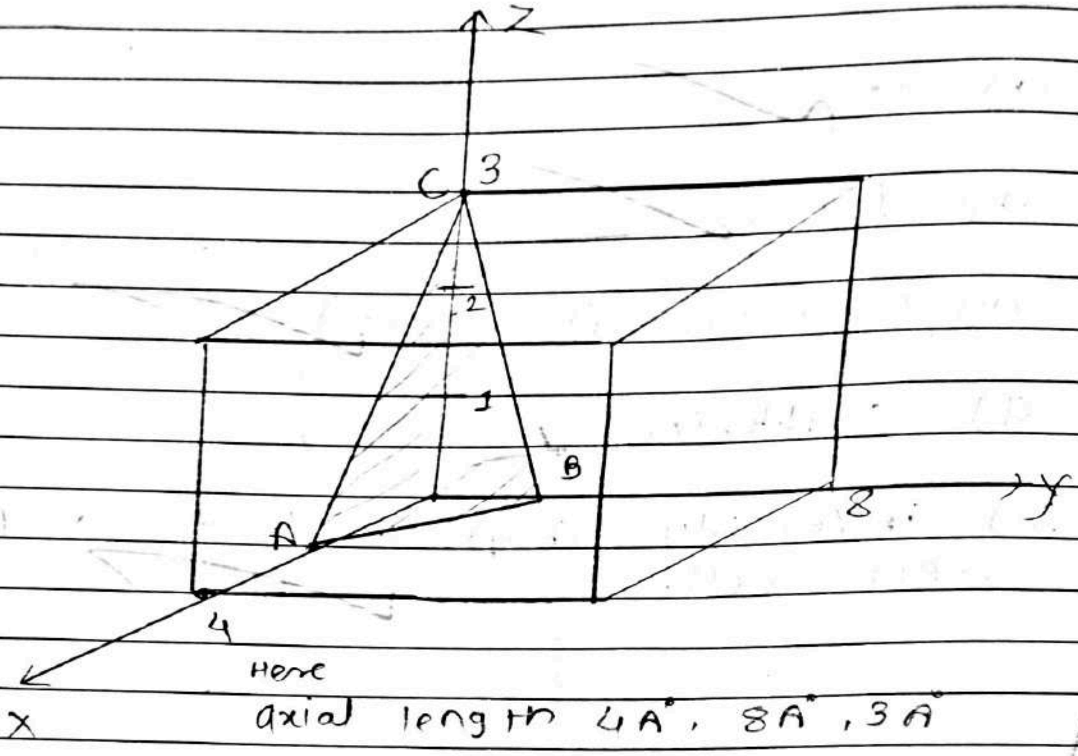
iv) a) scattering

v) b) inversaly propertional to volume of unit cell.

Q. No.				TOTAL				TOTAL
Marks								

Q. No.

Q. 2.
ii)



Here
axial length 4Å, 8Å, 3Å

Defination:-
Orientation of a plane in a crystal can be described in terms of these reciprocal of intercept on 3 axis. Consider a plane ABC having intercept one axial unit on x axis, 4 axial unit of y axis & 3 axial unit on z axis as shown in fig.
The numerical parameter of the plane are, 1, 4 & 3 but according to Miller it is more useful to denote or discribe this parameters by taking reciprocal of it's numerical value.

This parameters are called as 'Miller indices.

Axial length	4 A	8 A	3 A
Intercept	1 A	4 A	3 A
Fractional intercept	$\frac{1}{4}$	$\frac{4}{8}$	$\frac{3}{3}$
Reciprocal miller indices.	4	2	1.

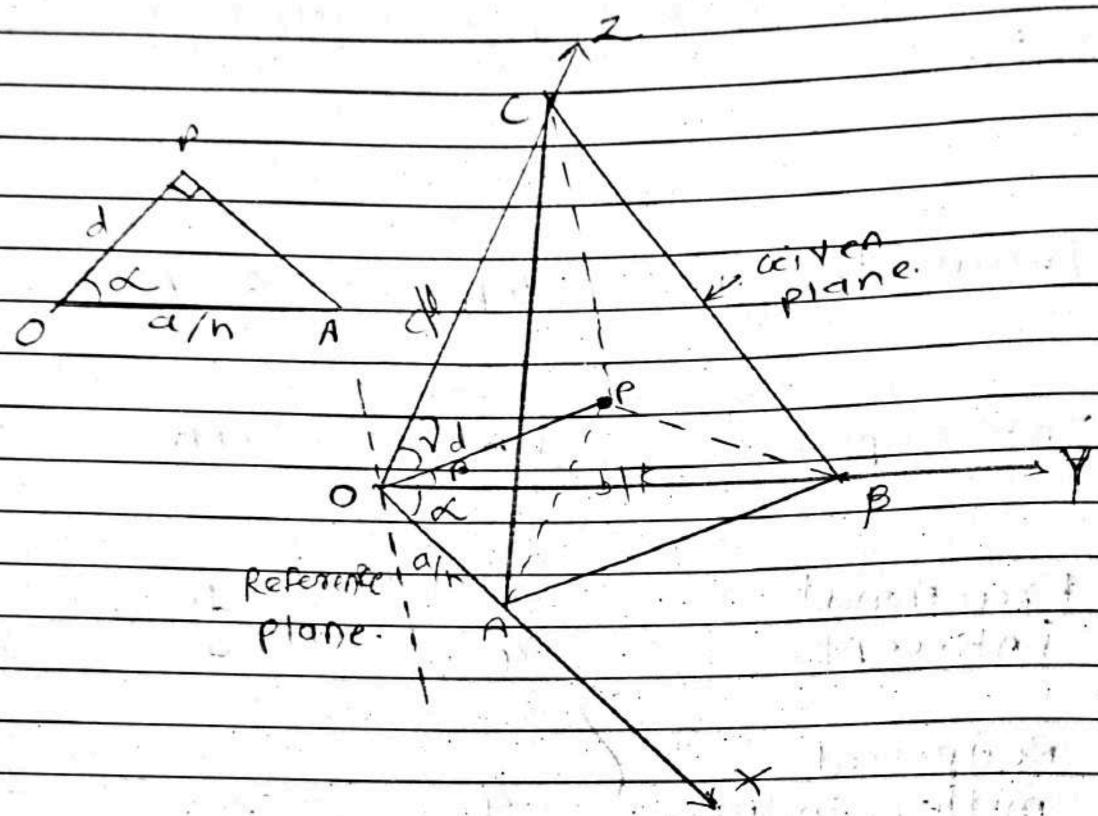
miller indices of ABC plane are (4 2 1) denoted by h k l that is

$$(h\ k\ l) \equiv (4\ 2\ 1)$$

Now. relation in terms of interplaner Spacing and lattice parameters.

Q. No.				TOTAL				TOTAL
Marks								

Q. No.



$l(OA) = a/h$

$l(OB) = b/K$

$l(OC) = C/l$

Consider the axis XYZ mutually perpandicular to each other.

Consider the reference plane passes through the origine & the other plane ABC cuts the plane intercept a/h on X axis, b/k on Y axis & c/l on Z axis. a normal AP is drawn to the plane ABC from the origine.

Q. No.				TOTAL				TOTAL
Marks								

Q. No.

let, 'd' be the perpandicular distance betn reference plan & given plane.

let, (h k l) miller indices of given plane ABC.

let, 'α' = be the angle betn normal & OA

β = angle betn normal & OB

γ = angle betn normal & OC.

let cos α, cos β, cos γ be the direction cosine of normal.

By using geomerory,

$$\cos\alpha = \frac{d}{a/h}$$

$$\cos\beta = d / b/k$$

$$\cos\gamma = d / c/l$$

But $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$$\left(\frac{d}{a/h}\right)^2 + \left(\frac{d}{b/k}\right)^2 + \left(\frac{d}{c/l}\right)^2 = 1$$

Q. No.				TOTAL				
Marks								

Q. No.

$$\frac{d^2h^2}{a^2} + \frac{d^2k^2}{b^2} + \frac{d^2l^2}{c^2} = 1$$

$$d^2\left[\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}\right] = 1$$

$$d^2 = \frac{1}{\left[\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}\right]}$$

$$\boxed{d = \frac{1}{\sqrt{\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}}}}$$

this is the relation betn interplaner distance & miller indices.

Case1:-

For cubical System

$a = b = c$

$$\therefore d = \frac{1}{\sqrt{\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}}}$$

$$d = \frac{1}{\sqrt{\frac{h^2+k^2+l^2}{a^2}}}$$