G. S. Mandal's

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

END SEMESTER EXAMINATION

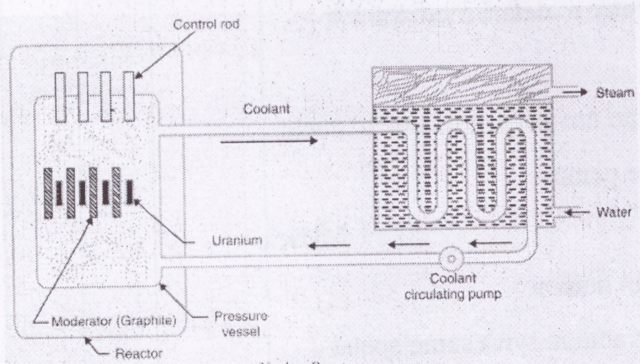
April/May 2022

Class: First year **Date:**

Course: Open Elective-I: Engineering Physics **Time: 2 hr**

Max Marks: 50

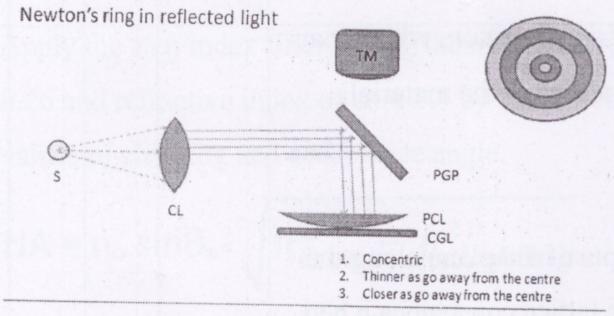
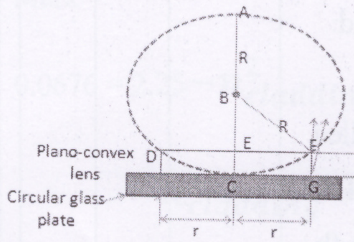
Q. 1	**Solve/Answer any five**	**10 Marks**				
	Questions	Marks	CO	BL	PO	PI
a	State the characteristics of electromagnetic waves. 1. They do not require any material medium for their propagation. 2. The oscillations of and are perpendicular to each other and are in same phase. 1 Mark 3. They are transverse in nature. 4. They travel through vacuum with same speed 1 Mark	2	1	1	1	1.1
b	Define nuclear fusion. Nuclear fusion is a reaction where lighter atomic nuclei fuse together to create a larger nucleus and in the process releases energy. 2 Mark	2	1	1	1	1.1
c	State the formula for crystal structure. Lattice + basis = crystal structure	2	1	1	1	1.1
d	What is the formula relating wavelength to the momentum as per the de Broglie hypothesis? $\lambda = h/p$ 1 Marks $\lambda = h/mv$ 1 Marks	2	1	1	1	1.1
e	State any two properties of nanomaterial. Superparamagnetism in small ferromagnetic particles (i.e. particles which are ferromagnetic in bulk) with	2	1	1	1	1.1

	Zero coercivity, zero remanence, high saturation magnetization. Reduction of grain size, higher structural disorder, increased surface of grain boundary, barrier for dislocation movement leading to higher material strength. Nanoparticles' exhibit change in color with change in size due to the surface plasmon resonance effect, which is a resonance of the outer electron bands of the particles with light wavelengths.					
f	Label the parts by drawing nuclear reactor.  Nuclear Reactor Drawing 1 Marks Labels 1 Marks	2	1	1	1	1.1
Q. 2	**Solve the following questions**			**8 Marks**		
a)	Solve for calculating specific rotation of the given sample of sugar solution if the plane of polarization is turned through 13.2°. The length of tube containing 10 % sugar solution is 20cm $$S = \frac{10 * \theta}{l * c}$$ 1 Mark S = specific rotation θ = angle of rotation = 13.2° L = The length of tube 20cm 1 Mark	4	3	3	1	1.3

	$$S = \frac{10 * 13.2}{20 * 10/100}$$ 1 Mark S =66 deg·mL·g−1·dm−1 1 Mark					
b)	A beam of X-rays of wavelength 0.071 nm is diffracted by rock salt in which the atomic planes are 1.979 Å apart. Find the glancing angle for the second-order diffraction. $2d\sin\theta = n\lambda$ 1 Mark $\lambda = 0.071$ nm d = 1.979 Å = 0.1979 nm 1 Mark second-order diffraction : n = 2 $2*0.1979*10^{-9}*\sin\theta = 2*0.071*10^{-9}$ 1 Mark $\sin\theta = 2*0.071*10^{-9} / 2*0.1979*10^{-9}$ $\theta = \sin^{-1} 0.3587$ $\theta = 21.02^0$ 1 Mark	4	3	3	1	1.3
Q. 3	**Solve the following questions**					**8 Marks**
a)	In an auditorium of dimensions length 12 m, breadth 10 m and height 8 m, what will be the change in the reverberation time for the auditorium hall with no audience and full capacity of audience (100 persons) if the total absorption of the hall is 181.2 and absorption per person is assumed to be 0.46 / person. $t = 0.161\frac{V}{A}, where\_A\_is\_\sum aS$ $t = 0.161\frac{12*10*8}{181.2}$ 1 Mark $t = 0.8529\,\text{sec}$	4	3	3	2	2.2

	$t = 0.161\frac{12*10*8}{181.2+(100*0.46)}$ 1 Mark $t = 0.680\,\text{sec}$ 1 Mark $t = 0.8529 - 0.680$ 1 Mark $t = 0.1729\,\text{sec}$					
b)	Apply the step index fiber having the numerical aperture 0.26 and refractive index of core 1.5 by finding the values of cladding and acceptance angle. $NA = n_o \sin\theta_a = \sqrt{n_{Core}^2 - n_{cladding}^2}$ 1 Mark $NA = \sqrt{n_{Core}^2 - n_{cladding}^2}$ 1 Mark $0.0676 = 2.25 - n_{cladding}^2$ $n_{cladding}^2 = 2.25 - 0.0676$ refractive index of cladding =1.477 1 Mark acceptance angle $\sin^{-1} NA$ $\sin^{-1} 0.26 = 15.07^o$ 1 Mark	4	3	3	2	2.2
Q. 4	**Solve the following questions**					**8 Marks**
a	Explain Miller indices notation for atomic planes. Miller Indices are the convention used to label lattice planes. This mathematical description allows us to define accurately, planes within a crystal, and quantitatively analyse many problems in materials	4	2	2	1	1.2

	science. Miller Indices are a method of describing the orientation of a plane or set of planes within a lattice in relation to the unit cell. They were developed by William Hallowes Miller. 1 Mark These indices are useful in understanding many phenomena in materials science, such as explaining the shapes of single crystals, the form of some materials' microstructure, the interpretation of X-ray diffraction patterns, and the movement of a dislocation, which may determine the mechanical properties of the material. 1 Mark Step 1: Determine the intercepts of the plane along the axes X,Y and Z in terms of the lattice constants a,b and c. Step 2: Determine the reciprocals of these numbers. Step 3: Find the least common denominator (lcd) and multiply each by this lcd. Step 4:The result is written in paranthesis.This is called the `Miller Indices' of the plane in the form (h k l). This is called the `Miller Indices' of the plane in the form (h k l). 2Mark					
b	Summarize the liquid drop model for nucleus formation. 1. It was the first model of nuclei. The motivation was to describe the masses and binding energy of nuclei. 2. It is called the Liquid Drop Model because nuclei are assumed to behave in a similar way to a liquid. 3. The molecules in a liquid are held together by	4	2	2	1	1.2

	Van der Waals force that is only between near neighbors. 4. The nuclear force is a short range force that appears to act only between neighboring nucleon. Each point 1 Mark					
Q. 5	Analyze the role of interference of light in Newton's ring experiment.  **1 Mark**  R = radius of curvature r = radius of the ring t = thickness of air film In △ BEF, Angle BEF = 90° $BE^2 + EF^2 = BF^2$ $(BC - EC)^2 + EF^2 = BF^2$ $(R - t)^2 + r^2 = R^2$ $R^2 - 2Rt + t^2 + r^2 = R^2$ $r^2 = 2Rt$ $t = \frac{r^2}{2R}$ .... (1) **1 Mark**	8	4	4	2	2

	$R*(2n-1)\frac{\lambda}{2}=\left(\frac{D}{2}\right)^2$ $R*(2n-1)\frac{\lambda}{2}=\frac{D^2}{4}$ $R*(2n-1)\lambda=\frac{D^2}{2}$ $2\lambda R*(2n-1)=D^2$ $D=\sqrt{2\lambda R*(2n-1)}$ $D\propto\sqrt{odd\_natural\_numbers}$ **2 Mark** $r^2=Rn\lambda$ $\left(D^2/4\right)=Rn\lambda$ $D^2=4Rn\lambda$ $D=\sqrt{4Rn\lambda}$ $D\propto\sqrt{n}$ $D\propto\sqrt{natural\_numbers}$ **2 Mark** For the expression of wavelength of light, $D_n^2=4Rn\lambda$ $D_{n+m}^2=4R(n+m)\lambda$ $D_{n+m}^2-D_n^2=4R(n+m)\lambda-4Rn\lambda$ $\lambda=\frac{D_{n+m}^2-D_m^2}{4mR}$ **2 Mark**					

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<td>Q. 5</td>
<td>Analyze the methods of production of ultrasonic waves.

The piezoelectric effect was discovered in 1880 by two French physicists, brothers Pierre and Paul-Jacques Curie. Naturally occurring: quartz, tourmaline, and Rochelle salt (potassium sodium tartrate).

Synthesized: Potassium niobate (KNbO3) and lead zirconate titanate (PZT (Pb[ZrxTi1−x]O3 with $0 \le x \le 1$)). Exhibit a more pronounced piezoelectric effect. When a crystals like (calcite or quartz) under goes mechanical deformation along the mechanical axis then electric potential difference is produced along the electrical axis perpendicular to mechanical axis. This phenomenon is known as piezoelectric effect.

1 Mark

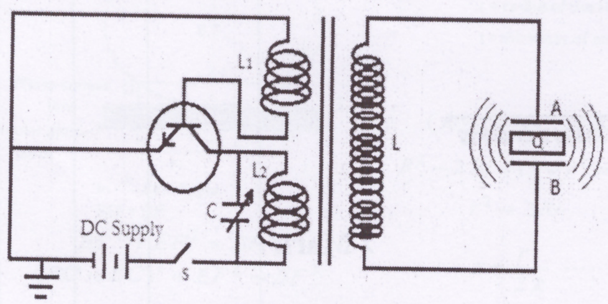

Fig. 7.1: Piezoelectric Oscillator

1 Mark

$F = \frac{1}{2\pi\sqrt{L_2 C}}$ $F = \frac{k}{2t}\sqrt{\frac{Y}{\rho}}$ 2 Mark</td>
<td>8</td>
<td>4</td>
<td>4</td>
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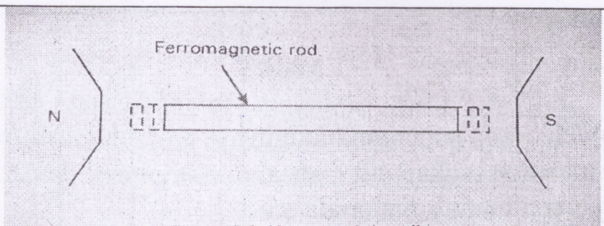
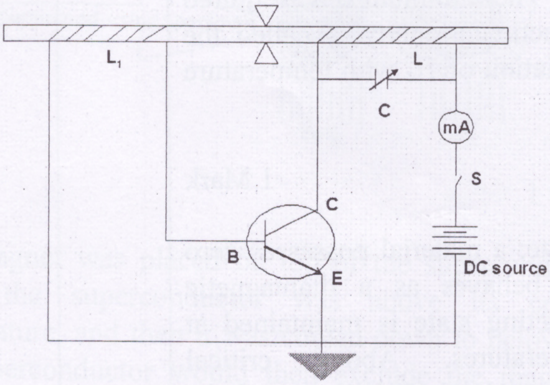
	 Figure 2.1: Magnetostriction effect 1 Mark  1 Mark Circuit working 1 Mark Effect explanation 1 Mark					
Q. 6	Make inference about the experimental observations of superconductivity. The phenomenon of sudden disappearance of electrical resistivity in materials when it is cooled to sufficiently low temperature is called superconductivity. The materials that exhibit superconductivity and which are in the superconducting state are called superconductors. This was first observed by Kammerlingh Onnes in 1911 while measuring the resistivity of mercury at low temperatures. 1 Mark **Effect of magnetic field**: In the superconducting state, a material possesses zero electrical resistance and behaves as a diamagnetic material. Below Tc if sufficiently strong magnetic field is applied, the superconducting property of the material is destroyed and the material reverts back to its normal state. The minimum field required to destroy the superconducting property is known as the critical	**8**	4	4	2	2

magnetic field (Hc).

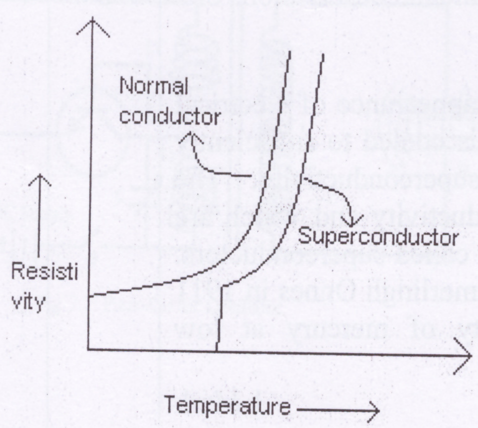
1 Mark

The magnetic field at which the superconducting property of a material disappears is called as critical magnetic field. When the superconducting materials are subjected to a strong magnetic field, it will result in the destruction of the superconducting property, i. e. they return to the normal state. The minimum field required to destroy the superconducting property is called the critical field (H_c). The variation of H_c with temperature is as shown,

1 Mark

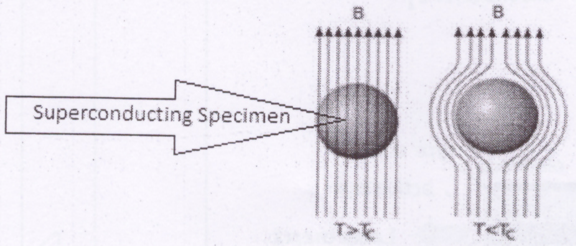
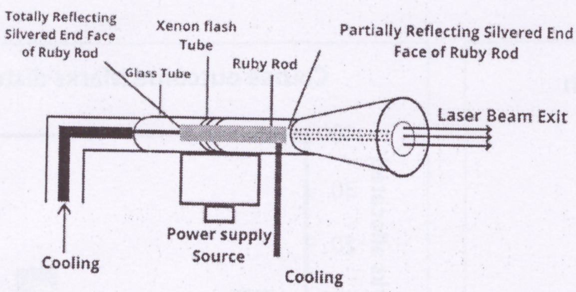
Effect of Temperature:
In the superconducting state, a material possesses zero electrical resistance and behaves as a diamagnetic material. This superconducting state is maintained at sufficiently low temperatures. Above critical temperature T_c, the superconducting property of the material is destroyed and the material reverts back to its normal state. The transition temperature (Tc) is the critical temperature at which the resistivity of the material suddenly changes to zero. The temperature at which the normal conductor loses its resistivity and becomes a superconductor is known as transition temperature or critical temperature (T_C).

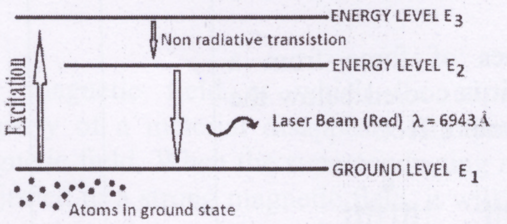
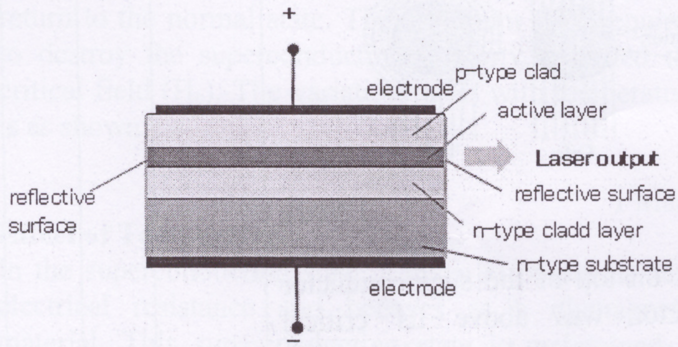
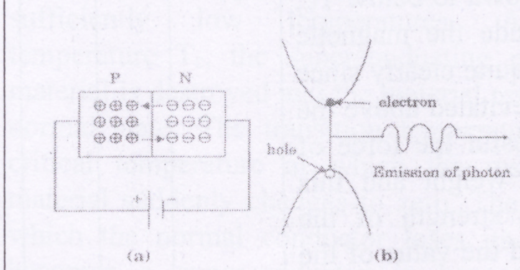
1 Mark



1 Mark

Meissner effect:
When a weak magnetic field is applied to a superconducting specimen at a temperature below transition temperature (T_c), the magnetic flux lines are expelled. The Specimen acts as an ideal diamagnetic. This effect is called “Meissner effect”.

	1 Mark The expulsion of magnetic lines of force from a superconducting specimen when it is cooled below the critical temperature is called Meissner effect.  1 Mark If a magnet was placed on top of the superconductor when the superconductor was above its critical temperature, and then it was cooled down to below T_C, the superconductor would then exclude the magnetic field of the magnet. This can be seen quite clearly since magnet itself is repelled, and thus is levitated above the superconductor. For this to be successful the force of repulsion must exceed the magnet's weight and this phenomenon will occur only if the strength of the applied magnetic field does not exceed the value of the Critical Magnetic Field, H_C for that superconductor material. 1 Mark					
	OR					
Q. 6	Compare the features of ruby laser with those of semiconductor laser  	8	4	4	2	2

	   Each diagram 1 mark = total 4 marks Each comparing point 1 mark = total 4 marks					

Blooms Level Wise Marks Distribution

Course Outcome Wise Marks Distribution