B. TECH. SEM I (CBCS)

Subject—Applied Physics

Question bank for practice

RTMNU TG NOTES GROUP LINKS	CONSTONT FOR SOLVING PROBLEMS
➢ Join our notes Community Telegram group @rtmnuengineeringnotes ➢ Join Telegram Group For notes reference and connect students with Different Colleges. @rtmnufyfriendcircle ➢ Msg us if you have any queries @RTMNUPDATES	**List of constants for solving problems**: Velocity of light c = 3 x 10^{8} m/s Charge of electron e = 1.602 x 10^{-19}C Mass of electron m = 9.11 x 10^{-31}Kg 1 electron volt =1.602 x 10^{-19} J Avogadro's number N_A= 6.023x 10^{26} atoms/K mol Plank's Constant = 6.63 x10^{-34} J.s 1 amu = 1.67 x 10^{-27} Kg

UNIT 1-WAVE OPTICS

1	1What is thin film? Obtain an expression for Fringe width of the interference due to reflected rays in wedge shaped thin film.	4
2	Explain in brief two methods of obtaining interference patterns.	4
3	In Newton's rings experiment,explain why: i) Plano-convex lens should have larger radius. ii) Rings get closer away from centre. iii) Central fringe is dark in reflected light. iv)Fringes are circular.	6
4	What is meant by interference of light? What are the necessary conditions on the path difference between two waves that interfere (a) constructively (b) destructively.	3
5	What is thin film? Write an expression for path difference for maxima and minima in a thin film of constant thickness due to reflected lightand obtain the conditions for dark and bright fringes of interference pattern.	4
6	What is Resolving Power of the grating? Write an expression for the resolving power of grating in terms of two closely spaced wavelengths.	2
7	What is antireflection coating.? Deduce an expression for the minimum thickness of the antireflection coating.	4

8	Explain antireflection coating. Obtain the condition for minimum thickness of such a coating.	4
9	Draw a neat diagram of experimental set up for the Newton's rings formation. Obtain an expression for diameter of dark ring and bright ring.	5
10	Derive an expression for fringe width in interference pattern obtained in wedge shaped thin film. How is this phenomenon used for testing the optically flat surface?	5
11	Obtain an expression for minimum optical thickness of the film to act as an antireflection coating	3
12	Derive an expression for fringe width in an interference pattern formed in a Wedge-shaped thin film	4
13	Write an expression for path difference in thin film of constant thickness. State the conditions for dark and bright fringes of interference pattern.	3
14	Explain the formation of Newton's rings with a neat diagram.	4
15	Explain the difference between interference and diffraction.	3
16	What is a diffraction grating? What is grating element? Give two applications of diffraction.	4
17	What is diffraction grating? How will you determine the wavelength of incident light using plane	4
	transmission grating?	
18	Define resolving power and write an expression for resolving power of the diffraction grating.	3
19	How is the ring diameter and thickness of film related in Newton's rings formation for dark fringe?	4
20	A wedge-shaped thin glass plate of refractive index 1.52 is used to observe fringes of equal thickness. The fringe spacing is 1 mm and the wavelength of light used is 5893A0. Calculate the angle of the wedge	3
21	Newton's ringsare observed in the reflected light of $\lambda=5.9 \times 10^{-5}$cm. The diameter of the 10^{th} ring is 0.5 cm. Find the radius of the curvature of the lens.	3
22	A glass microscope lens is coated with magnesium fluoride ($\mu=1.38$) film to increase the transmission of normally incident light of wavelength 6800 Å. What is the minimum film thickness needed for optimum result?	3
23	In a Newton's ring experiment the diameter of the 15th ring is 0.590 cm. and that of the 5th ring is 0.336cm. If the radius of the Plano convex lens is 100cm, calculate the wavelength of the light used.	3
24	Light of wavelength 6000 Å falls normally on a thin wedge-shaped film of refractive index 1.4, forming fringes that are 2 mm apart. Find the angle of the wedge.	3
25	A glass microscope lens ($\mu=1.5$) is coated with magnesium fluoride ($\mu=1.38$) film to increase the transmission of normally incident light $\lambda=5800$Å. What minimum film thickness should be deposited on the lens?	3
26	What is the difference between Fraunhofer and Fresnel diffraction?	3

UNIT I1-QUANTUM MECHANICS

1	What is Compton effect? On the basis of quantum theory, explain the existence of modified and unmodified components in Compton scattering.	4
2	Describe Davison and Germer experiment, which shows the existence of matter waves.	4
3	What is de-broglie hypothesis? Show that de-broglie wavelength of electron accelerating through potential V is given by $\lambda = \frac{12.26}{\sqrt{V}}$	3
4	State Heisenberg Uncertainty Principle and explain the significance of Heisenberg Uncertainty Principle in microscopic particle with example.	4
5	Show that the energy of an electron confined in 1-D potential well of length 'L' and finite depth is quantized. Is the electron trapped in potential well allowed to take zero energy? Why?	2
6	Give the physical significance of wave function. What is the condition of normalization?	4
7	In Compton Effect what happens when (i) Photon collides with free electron in scattering block. (ii) Photon collides with bound electron in scattering block.	4
8	State the Heisenberg's Uncertainty principle?Why is it not significant for macroscopic bodies?	5
9	Show that the energy of a micro particle confined in an infinite one-dimensional potential well of length 'l' is quantized.	5
10	Define wave function What are the properties of wave function?	3
11	Why intensity of modified wavelength is higher than that of unmodified wavelength for low atomic number scatterer during Compton scattering.	4
12	Why wave nature of particle is not apparent in our daily observations?	3
13	What is a wave packet? Why cannot a single monochromatic wave represent a particle?	4
14	Write down one -dimensional Schrodinger time dependent and time independent wave equations.	3
15	Compton effect is not observable in case of visible light. Explain.	4
16	Show that the wave function far a particle in a one- dimensional potential well of length L &infinite depth is given by $\psi_n(x) = A \sin(n\Pi x/L)$ where A is given by $\sqrt{2}/L$.	4
17	What is Compton effect? Write the expression for Compton shift.	3
18	In Compton Effect, write down the equations of energy and momentum conservation,	4
19	Prove that electrons do not pre-exist in nucleus.	
20	What is de-Broglie hypothesis? Show how the quantization of angular momentum follows the concept of matter waves.	3
21	An electron is confined to move between two rigid walls separated by 1nm. Find first two allowed energy levels.	3

22	Calculate the wavelength associated with a stone of mass 50gms moving with speed of 50m/s and an electron accelerated through potential difference of 100Volts.	3
23	Calculate the lowest three permissible energies of an electron if it is bound by an infinite potential well of width 2.5 $x10^{-10}$ m.	3
24	An electron and a 150gm baseball are travelling 220m/sec, measured to an accuracy of 0.005%. Calculate & compare uncertainty in position of each.	3
25	Find the lowest three energy of an electron is confined to move in a one- dimensional potential well of length 1Å. Express the result in eV.	3
26	An X- ray of wavelength 0.3Å is scattered through an angle 45°by a loosely bound electron. Find the wavelength of scattered photon.	3
27	A beam of X-rays is scattered by loosely bound electrons at 45° from the direction of beam. The wavelength of the scattered X-rays is 0.22 Å . What is the wavelength of the incident X-rays?	3

UNIT II1-CRYSTAL STRUCTURE

1	Define: (i) Space lattice, (ii) Coordination number and (iii) Void space	3
2	Define: (i) Miller indices (ii) Unit cell.	2
3	Define 1. Space lattice 2. Coordination number 3. Effective no. of atoms per unit cell 4. Atomic packing fraction.	4
4	Define 1. Coordination number 2. Void space 3. Atomic radius.	3
5	Show that FCC has maximum atomic packing fraction compared to BCC and SC unit cell.	4
6	Compute atomic radius for SC, BCC and FCC structure.	5
7	Show that FCC structure possesses maximum packing density (APF) and minimum percentage of void space among BCC and FCC.	6
8	Calculate the atomic radii and packing fractions for Body Centred and Face Centred Cubic Unit Cell.	4
9	Define Miller Indices. What are the steps of finding miller indices?	3
10	Draw crystal planes having Miller Indices (020), (111) and (210).	3
11	Draw the planes having miller indices (100), (101) and (211) in a cubic crystal.	3
12.	Draw crystal planes in a cubic crystal for given Miller Indices: (221), (001) and (320).	3
13.	Derive the relation between lattice constant (a), Interplanar spacing (d) and Miller indices (hkl).	3
14.	Obtain an expression for interplanar spacing between two adjacent planes of Miller indices (hkl) in a cubic crystal.	4
15	Derive Bragg's law of X-Ray diffraction. Why are X-rays used to study diffraction in crystals?	4
16.	Derive Bragg's law of X-ray diffraction in crystals. State any one application of it.	4
17.	State and derive Bragg's law of X-Ray diffraction. Why it is not useful in amorphous solids?	4
18.	Calculate the number of atoms per unit cell in SC, BCC and FCC unit cells.	5

19.	In a cubic lattice, prove that: $d_{hkl} = \frac{a}{\sqrt{(h^2 + k^2 + l^2)}}$ where d_{hkl} is the interplanar distance, a is lattice constant and h, k, l are the Miller Indices.	3
20.	Aluminium has FCC structure. Its density is 2700 kg /m^3. Calculate the unit cell dimension and the atomic diameter. Atomic weight of Aluminium = 26.98.	3
21.	X-ray with a wavelength of 1.54A^o is used to calculate the spacing of plane (200) in Aluminium. The Bragg's angle for this reflection is 22.40. What is the size of the unit cell of the Aluminium crystal?	3
22.	The density of copper is 8980 kg / m^3 and unit cell dimension is 3.61 Å. Atomic weight of copper is 63.54. (i)Determine crystal structure (ii) Calculate atomic radius.	4
23.	X- rays of unknown wavelength give first order Bragg reflection at glancing angle 20^o with (212) planes of copper having F.C.C. structure. Find wavelength of X-rays if the lattice constant for copper is 3.615 Å.	4
24.	Sodium crystallizes in a cubic lattice. The edge of the unit cell is 4.3 A. The density of sodium is 963 kg/m^3, its atomic weight being 23. What type of unit cell does sodium form?	3
25.	Find the spacing of (2 1 2) and (0 3 0) planes in a FCC crystal having lattice constant 5 Å and also find radius.	4
26	X- rays of unknown wavelength give first order Bragg reflection at glancing angle 20^o with (212) planes of copper having F.C.C. structure. Find wavelength of X-rays if the lattice constant for copper is 3.615 Å.	3

1	What is an optical fibre? Explain the principle behind the working of Optical Fibre.	4
2	What is optical fibre? Explain the structure of optical fibre.	3
3	What is acceptance angle? Derive the expression for acceptance angle in step index optical fibre.	4
4	Explain the terms: i) Critical angle ii)Acceptance angle iii)Numerical aperture	3
5	Explain the phenomenon of total internal reflection of light in an optical fibre.	2
6	Explain Single mode step index, graded index and multimode step index optical fibre. Draw relevant sketches.	4
7	Derive the mathematical expression for the numerical aperture and acceptance angle for step index fibre	4
8	Explain types of optical fiber on the basis of material used.	3
9	What is the difference between step index fibre and graded index fibre?	3
10	What is Acceptance cone?	2
11	Give the classification of optical fiber on the basis of refractive index profile with suitable diagrams.	4

12	Derive an expression for numerical aperture of a step index fibre in terms of Δ.	2
13	Explain the advantages of optical fibre over conventional wire.	3

UNIT IV- OPTICAL

14	What is attenuation? What are the causes of attenuation?	3
15	What is dispersion in optical fiber? State the different mechanisms that contribute for dispersion.	4
16	Explain the application of optical fibre as a liquid level detector.	3
17	Discuss the working of optical fibre as a temperature sensor with suitable diagram.	4
18	Discuss any one application of an optical fibre as a sensor.	4
19	Define attenuation. Discuss various mechanisms of attenuation.	4
20	What is acceptance angle? Derive the mathematical expression. How is it related to numerical aperture?	1+3 +1
21	A glass clad fiber is made core glass of refractive index 1.5 and cladding is doped to give a fractional index difference of 0.0005. Find cladding R.I and Acceptance angle	3
22	What is the attenuation in dB/Km, if 15% of the power fed at launching end of 1/2 km fibre is lost during propagation?	3
23	The core has Refractive index 1.6 and the clad has refractive index 1.3. What is the value of critical angle? Also calculate the value of angle of the cone of acceptance.	3
24	The numerical aperture of an optical is 0.5 and the core refractive index is 1.54. Find the refractive index of cladding.	4
25	Find the fractional refractive index and numerical aperture for an optical fibre with refractive indices of core and cladding as 1.5 and 1.49 respectively.	3
26	An optical signal has lost 85% its power after traversing 500 m of fibre. What is the loss in dB/Km of this fibre?	3

UNIT V-ELECTRON

1	What is Velocity Selector? Explain its working with a suitable diagram.	3
2	State and explain the law of refraction of an electron beam.	3
3	What is Bethe's law? Discuss the similarities and differences between Bethe's law and Snell's law.	5
4	Explain the function of CRT in a cathode ray oscilloscope with well labelled diagram.	4
5	Draw the block diagram of CRO. Explain the role of aquadag coating in CRT.	4
6	In CRO, explain 1. Role of Time Base circuit 2. Synchronization	4

7	In CRO, explain 1. Blanking 2. Lissajous figures.	4
8	Draw the block diagram of CRO. Explain the function of delay line in CRO.	4
9	Draw the neat block diagram of CRO. Explain how the intensity and sharpness of trace on the screen is controlled.	5
10	Explain the construction and working of the Bainbridge mass spectrograph with a suitable diagram.	4
11	Draw the Block diagram of CRO and explain the role of electron gun.	3
12.	In Bainbridge mass spectrograph, show that the mass scale is linear. Derive expression for line separation.	4
13.	Discuss the refraction of an electron beam across an equipotential surface.	4
14.	Explain the function of aquadag coating on the screen of CRT.	3
15	Explain in brief the working of an electrostatic focusing lens.	4
16.	In CRO, explain in brief the working of 1. Time -base circuit 2. Trigger circuit	4
17.	What are Lissajous patterns? Define Synchronization. How is the intensity of the trace controlled on the screen of CRO?	1+1+2
18.	Explain Bethe's Law with the help of necessary diagram and discuss the similarities with Snell's Law.	4
19.	Draw the schematic of an electrostatic CRT. Write the function of (i) Electron gun (ii) Deflection system (iii) Fluorescent screen (iv) Aquadag coating	5
20.	Electrons accelerated by a potential of 250 V enter the electric field at an angle of incidence of 50^o and get refracted through an angle of 30^o. Find the potential difference between the two regions.	3
21.	In the Bainbridge mass spectrograph, the electric field used is 8×10^4 V/m, and the magnetic field common to both places is 0.2 Wb/m^2. If the ion source consists of singly ionized neon isotopes of atomic mass 20 and 22, calculate linear separation of lines formed on a photographic plate.	3
22.	A positive ion beam moving along the x-axis enters a region of the uniform electric field of 10^4 V/m along Y-axis and magnetic field of 0.02T along z-axis. Calculate the speed of ions, which pass undeflected. What will happen to the ions, which are moving (i) faster, (ii) slower than these ions?	4
23.	In a Bainbridge mass spectrograph, the electric field used is 25 kV /m and magnetic field is 0.2 Wb/m^2. The element Tin is being analysed having isotopes of masses 116 and 120. Find the linear separation of lines produced on the photographic plate by the singly charged ions of Tin 116 and 120.	3

24.	In a Bainbridge mass spectrograph, singly ionized atoms of Ne^{20} passes into a deflection chamber with a velocity of 10^5 m/sec. if they are deflected by a magnetic field of flux density of 8 x 10^{-2} Wb/m^2, Calculate the radius of the path of singly ionized Ne^{20} atom.	3
25.	An electron beam enters from a region of potential 75 V into a region of potential 100V, making an angle of 45^0 with the direction of electric field. Find the angle through which the beam refracts.	3