VIT
Vellore Institute of Technology
CHENNAI

Reg. Number:	23BAJ1038

Continuous Assessment Test (CAT) – II- APRIL 2024

Programme	:	B.Tech	Semester	:	Win 23-24
Course Code & Course Title	:	BPHY101L Engineering Physics	Class Number	:	CH2023240500308 CH2023240500320 CH2023240500288 CH2023240500280 CH2023240500284 CH2023240500312 CH2023240500316 CH2023240500276 CH2023240500324
Faculty	:	Caroline P. Karthikeyan S Parasuraman E Punithavelan N. Rajasekarakumar V Sanjit Das Shalini M G Swaathi P Uthiram C	Slot	:	F1+TF1
Duration	:	90 minutes	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

Section A - **Answer all questions** (2×15=30)

Q. No	Sub Sec.	Questions	Marks
1.	a)	A subatomic particle Muon (mass = 1.88×10^{-28} kg) is confined in a 1-dimensional box of length 10 nm. Calculate the energies corresponding to the quantum numbers n= 1 to 3. Depict with appropriate neat figures the correlation of energy, wave function, and probability density function.	7
	b)	How do you prove the particle nature of radiation based on your understanding of this subject? Use only a conceptual approach.	3
	c)	Explain the physical phenomena involved in the confinement of particles in space and its influence on electronic and optical property variations of a substance at the sub-10 nm level.	5
2.	a)	If Davisson and Germer had used 90 volts to accelerate their electron beam instead of 54 volts, at which scattering angle φ would they have found a peak in the distribution of scattered electrons (the intensity)?	8
	b)	An electron is in a certain energy state in a one-dimensional, infinite potential well between x = 0 and x = L = 180 pm. The electron's probability density is zero at x = 0.200L, and x = 0.300L; it is not zero at intermediate values of x. The electron then jumps to the next lower energy level by emitting light. What is the change in the electron's	7

		energy?	
Section B - **Answer any two questions** (2×10 = 20)			
3.		Beams of an electron (mass = 9.1×10^{-31} kg) and a proton (mass = 1.6×10^{-27} kg) having a kinetic energy of 4 eV are made to incident on a barrier of width 1.5 nm and height U= 8.0 eV. Calculate the de Broglie wavelengths and tunneling probability of the electron and proton that penetrates through it. Comment on your observations. (4+4+2)	10
4.	a)	Describe the differences between the types of emissions responsible for the glowing of a 60 W bulb and the production of He-Ne laser in the laser cavity.	5
	b)	Given an emission wavelength of 7000 Å and the coefficient of spontaneous emission of 10^8 /s, what is the coefficient of stimulated emission? Also, calculate the corresponding frequency of laser light.	5
5.	a)	X-rays with an energy of 200 keV undergoes Compton scattering with a target. If the scattered X-rays make an angle 30° relative to the incident X-rays, calculate the energy of the incident photon and recoil electron at this angle.	6
	b)	What will be the uncertainty in position of an electron moving at a speed of 200 m/s with an accuracy of 0.01 percent?	4

**********All the best **********

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Reg. Number:	23BAI1028

Continuous Assessment Test (CAT) – I - FEB 2024

Programme	:	B.Tech	Semester	:	Win 23-24
Course Code & Course Title	:	BPHY101L Engineering Physics	Class Number	:	CH2023240500308 CH2023240500320 CH2023240500288 CH2023240500280 CH2023240500284 CH2023240500312 CH2023240500316 CH2023240500276 CH2023240500324
Faculty	:	Caroline P. Karthikeyan S Parasuraman E Punithavelan N. Rajasekarakumar V Sanjit Das Shalini M G Swaathi P Uthiram C	Slot	:	F1+TF1
Duration	:	90 minutes	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

Section A - **Answer all questions** (2×15=30)

Q. No	Sub Sec.	Questions	Marks
1.	a)	With suitable diagram and assumptions, derive the 1D-transverse wave equation which travels in a stretched string.	10
	b)	Show that $y = 2sinxcosvt$ is a solution to wave equation.	5
2.		Discuss the Maxwell's equation in vacuum and use it to derive the EM wave equation in terms of electric and magnetic fields.	5+10
Section B - **Answer any two questions** (2×10 = 20)			
3.	a)	The displacement of the wave on a string is given by $y = 4\ sin\ \pi\ (0.04x - 2t)$. Find the amplitude, frequency and velocity of the wave.	4
	b)	A rope with mass 1.39 kg and fixed at both ends, oscillates in a second harmonic standing wave pattern. The displacement of the rope is given by $y = (0.10\ m)\ \sin(\pi x/2)\ \sin 12\pi\ t$, where x =0 at one end of the rope, x is in meters and t is in seconds. What is (i) the length of the rope, (ii) the speed of the waves on the rope and (iii) the tension in the rope?	6

4.	a)	A string of impedance Z_1 = 4 kg/s is joined to a second string of impedance Z_2. The strings are along the z-direction and an incident wave $y = 0.4\cos(200\pi t - kz)$ is launched in string 'one' moving towards positive z and towards the junction of the two strings. Find Z_2 if 30% of the incident amplitude is reflected and the reflected wave is inverted relative to the incident wave.	4
	b)	Discuss the experiment that describes the generation of an EM wave	6
5.		For the following vector, $\vec{A} = x^2z\hat{\imath} + (y^2x - 2y^2z)\hat{\jmath} + xz\hat{k}$ (i) find the divergence and curl. (ii) find the $\nabla(\nabla \cdot \vec{A})$	5+5
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CHENNAI

Reg. Number:	

Continuous Assessment Test(CAT) – I - FEB 2024

Programme	:	**B.Tech.**	Semester	:	**Winter Semester 2023-2024**
Course Code & Course Title	:	**BPHY101L & Engineering Physics**	Class Number	:	**CH2023240500278 CH2023240500310 CH2023240500282 CH2023240500286 CH2023240500314 CH2023240500318 CH2023240500290 CH2023240500326 CH2023240500322**
Faculty	:	**Dr.R. Navamathavan Dr. Sanjit Das Dr.N. Punithavelan Dr.RajasekarakumarVadapoo Dr.S. Karthikeyan Dr.K. Divya Bharathi Dr.E. Parasuraman Dr.C.Uthiram Prof. B. Rishab Antosh**	Slot	:	**F2+TF2**
Duration	:	**1½ Hours**	Max. Mark		**50**

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

Section-A (Answer all Questions (2× 15 = 30))

Q. No	Sub Sec.	Description	Marks
1	a	Describe the standing wave pattern in a string of fixed-length. Derive and obtain the frequency of the first four harmonics with the necessary diagram.	12
	b	A tuning fork having a frequency of 512 Hz produces a wave of 0.67 m wavelength in air. Calculate the velocity of sound in air.	3
2		Write the Maxwell's equation in free space and using it, derive the wave equation for electric field and magnetic field in free space.	15
Section-B (Answer any TWO Questions (2×10 = 20))			
3		Calculate the value of α such that the curl of the following vector $\vec{A} = (\alpha xy + z^3)\hat{\imath} + (3x^2 - z)\hat{\jmath} + (3xz^2 - y)\hat{k}$ is zero vector. Write the physical significance of curl of a vector being zero.	10
4	a	The speed of a wave on a string is 100 m/s when tension is 70 N. How much additional percentage of tension is required to increase the wave speed by 10%?	4
	b	Prove that y=5sin2π(0.01x-4t) satisfies the wave equation.	3
	c	In electromagnetic waves, what is the inadequacy of Ampere's law? Explain.	3
5	a	How would you determine the transmission and reflection coefficients of a wave propagating across a boundary between two smoothly connected strings with same impedance? Provide a rationale for the obtained results. .	7
	b	Show that $\nabla.\vec{r} = 3$	3

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Reg. No:

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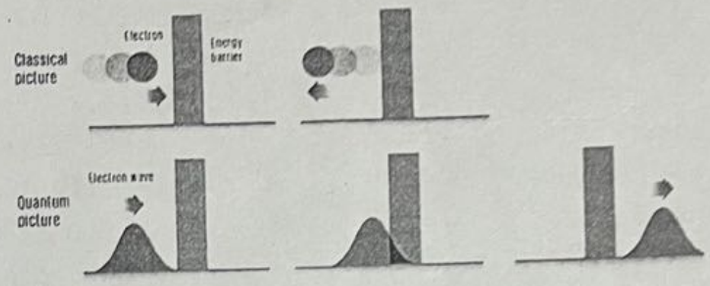
Name:

Continuous Assessment Test II – October 2023

Programme	:	**B.Tech.**	Semester	:	**Fall Semester 2023-2024**
Course	:	**Engineering Physics**	Code &	:	**BPHY101L**
			Slot	:	**D2+TD2**
Faculty	:	**Dr. Justin Raj C** **Dr. Karthikeyan S** **Dr. Ramkumar M C** **Dr. Rajasekarakumar V** **Dr. Parasuraman E** **Dr. Divya Bharathi K** **Prof. Rishab Antosh B**	Class number	:	**CH2023241700061** **CH2023241700069** **CH2023241700063** **CH2023241700067** **CH2023241700071** **CH2023241700059** **CH2023241700065**
Time	:	**90 minutes**	Max. Marks	:	**50**

Answer any FIVE Questions only (5 × 10 = 50)

Q. No	Questions	Marks
1	(a) You have been asked a question about the wave-particle duality of EM radiation. To justify your answer, you have been asked to use graphite as a target element. What will be your answer to that? How will you justify your answer (Without any derivation)? (b) A muon has a position uncertainty of 10^{-7} m. Calculate its minimum energy using uncertainty principle. (ii) If another muon was in the ground state of a 1D box of length 10^{-7} m, what will be its corresponding energy? (iii) Can you comment on the difference between the two results? Given mass of muon is 1.88×10^{-28} Kg.	5 + 5
2	(a) Through what angle must a 100 keV photon be scattered by an electron so that its wavelength increases by 5% in a Compton scattering experiment. (b) Explain the significance of double peaks in Compton experiment and indicate when do you observe a maximum wavelength shift.	6+4
3	For a given wave function, $\Psi(x) = A\cos(\frac{n\pi}{L}x)$. Normalize the wave function and find the probability amplitude, A for limit: x=0 and x= L/2.	10
4	(a) Find the kinetic energy of an electron whose de Broglie is same as that of a 70 keV X-ray. (b) A gold ball of 4 mm diameter is broken into very small pieces of 4 nm diameter. Explain the possible changes in their physical properties compared to its bulk form.	7+3

5	A beams of electron and proton with kinetic energy of 6 eV are made to incident on a barrier of width L=0.40 nm and height U=9.50 eV. Calculate the deBroglie wavelengths and tunneling probability of the electrons and protons to tunnel through it.	10
6	(a) If you are given the following image, what will be your explanation to the science enthusiasts? How will you convince them about the scientific phenomenon related to this?  (b) An electron is confined to a 1D box of length L. When the electron makes a transition from its third excited state to the second state, it emits a photon of energy 0.9 eV. (i) What is the ground state energy in eV of the electron in the box? (ii) Sketch the wave function of the electron in the second excited state.	4 + 6

VIT

Reg. No. : 23BCE1608

Final Assessment Test (FAT) - December 2023

Programme	B.Tech.	Semester	FALL SEMESTER 2023 - 24
Course Title	ENGINEERING PHYSICS	Course Code	BPHY101L
Faculty Name	Prof. M C Ramkumar	Slot	D2+TD2
		Class Nbr	CH2023241700063
Time	3 Hours	Max. Marks	100

Section-A (5 X 8 Marks)
Answer any 5 questions

01. a) Discuss the concept of reflection and transmission of wave on two different strings connected smoothly at the boundary with a neat sketch. (4 Marks) [8]
b) Wave equation of a string is given by $y = 0.02 \sin(300\,t - 15x)$, whose mass density is 0.1 kg m^{-1}. Find the wavelength and tension in the string. (4 Marks)

02. a) State the Ampere-Maxwell's law. (2 Marks) [8]
b) Find the divergence and curl of the given vector.
$\vec{f}(x,y,z) = x^2y\hat{\imath} - (z^3 - 3x)\hat{\jmath} + 4y^2\hat{k}$ (6 Marks)

03. (a) Find the kinetic energy of an electron whose de Broglie wavelength is the same as that of a 70 keV X-ray. (4 Marks) [8]
(b) An electron has a speed of 500 m/s with an accuracy of 0.003%. Calculate the uncertainty in it's location. (4 Marks)

04. Derive and explain the significance of relation connecting the Einstein's coefficients A and B. [8]

05. Consider light propagation in the optical fiber of step index fiber by total internal reflection. With suitable diagram, derive the expression for acceptance angle and numerical aperture. What is relative index parameter? [8]

06. a) Show that for a particular semiconductor, responsivity is directly proportional to the quantum efficiency of the photodiode. (5 Marks) [8]
b) A diode laser emits light of wavelength 532 nm and output power of 2 mW, calculate the number of photons emitted per second. (3 Marks)

Section B (4 X 15 Marks)
Answer any 4 questions

07. a) Considering a string with length L clamped at both ends, derive the equation for the standing wave produced. Find also the frequency and wavelength for different modes. (9 Marks) [15]
b) X-ray of wavelength 0.24 nm is Compton scattered and scattered beam is observed at an angle 60^o relative to the incident beam. Find the wavelength of the scattered X-rays. (6 Marks)

08. Obtain the Schrödinger time independent and time dependent wave equations. Write four significant properties of wave function. [15]

09. With diagram state the fundamental modes of vibration of CO_2 molecule. Explain the construction, working and applications of CO_2 laser. [15]

10. a) What is meant by pulse widening? How do you calculate the pulse widening in a step index fiber optic cable? How will you reduce and eliminate dispersion in an optical fiber. (9 Marks) [15]
b) In an optical, fiber, the core refractive index is 1.462 and the cladding refractive index is 1.435. Calculate (i) Critical incidence angle, (ii) Acceptance angle and (iii) Numerical aperture. (6 Marks)

11. (a) What is meant by quantum confinement? Based on dimension, briefly discuss with suitable diagram about various structures formed due to confinement. (8 Marks) [15]
(b) With a suitable diagram explain the working of p-i-n photodiode. What are its advantages when compared to a normal p-n photodiode? (7 Marks)

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Reg. Number:	BB1169

Continuous Assessment Test (CAT) – II - 2024

Programme	:	**B.Tech.**	Semester	:	**Winter Semester 2023-2024**
Course Code & Course Title	:	**BPHY101L & Engineering Physics**	Class Number	:	**CH2023240500278 CH2023240500310 CH2023240500282 CH2023240500286 CH2023240500314 CH2023240500318 CH2023240500290 CH2023240500326 CH2023240500322**
Faculty	:	**Dr.R. Navamathavan Dr. Sanjit Das Dr.N. Punithavelan Dr.RajasekarakumarVadapoo Dr.S. Karthikeyan Dr.K. Divya Bharathi Dr.E. Parasuraman Dr.C.Uthiram Prof. B. Rishab Antosh**	Slot	:	**F2+TF2**
Duration	:	**1½ Hours**	Max. Mark		**50**

General Instructions:

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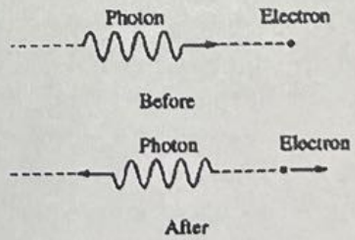
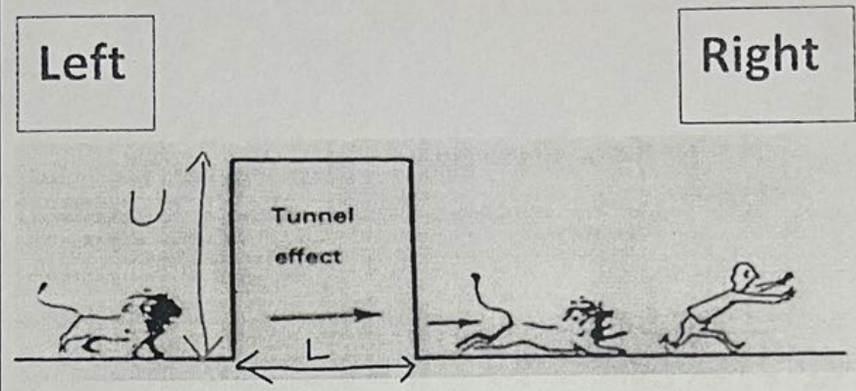
Section-A (Answer all Questions (2× 15 = 30))

Q. No	Sub Sec.	Description	Marks
1	a	A photon strikes an electron of mass m_0 which is at rest; after the collision the photon gains a wavelength by an amount of $\Delta\lambda$ and reversed in direction as shown in figure. $\lambda = 3.0 \times 10^{-11}$ m  i) Find the Compton shift ($\Delta\lambda$). ii) Find the energy in Joules of the scattered photon. iii) Determine the magnitude of the momentum acquired by the electron	7
	b	Consider a quantum particle confined in a region of $0 \leq x \leq a$, where the wave function is $\Psi(x,t) = (e^{-iwt})\sin(\pi x/a)$. Find the potential V($x$).	8

2	a	A beam of subatomic particles electrons and neutrons have the kinetic energy of 12 eV.  They fall on a barrier like above of width L=0.50 nm and height U=10 eV. Calculate the probability of the electrons and neutrons to pass from left to right by adopting the mechanism of quantum physics.	7
	b	Your friend who is interested in studying the morphology of a gold sample feels that the Scanning tunnelling microscope is a good choice to study the sample. What is your suggestion? Comment.	3
	c	Explain the physical significance and confinement of quantum particle in space inside matter with neat sketches. Explain the variation of physical properties of a matter at sub-10 nm level.	5
Section-B (Answer any TWO Questions (2×10 = 20))			
3	a	The position and momentum of deuteron ($_1H^2$) moving with frequency 10^{-7} Hertz are measured simultaneously. If its position is sighted within 0.5Å, what is the percentage of uncertainty in the momentum?	5
	b	An electron is moving in a one-dimensional infinite well of width 100Å. (i) Calculate the probability of finding the electron within an interval of 10Å at the centres of the box when it is in state of least energy. (ii) What would be the energy of the electron if it is set free out of the potential well?	5
4	a	A laser emits light of wavelength 550 nm. Find the ratio of the population between the two states at 300K.	3
	b	At what temperature would the population ratio reach 0.5, and what implication does this have for population inversion?	4
	c	Why is it difficult to achieve laser action at higher frequency range? Justify your answer with an expression.	3
5		A proton is confined in an infinite potential well of width 10 fm (The nuclear potential that binds protons and neutrons in the nucleus of an atom is often approximated by an infinite square well potential). Calculate the energy and wavelength of the photon emitted when the proton undergoes a transition from the first excited state to the ground state and in what region of the electromagnetic spectrum does this wavelength belong?	10

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Vellore Institute of Technology

Name: Yashvi

Continuous Assessment Test I – September 2023

Programme	:	**B.Tech.**	Semester	:	**Fall Semester 2023-2024**
Course	:	**Engineering Physics**	Code &	:	**BPHY101L**
			Slot	:	**D2+TD2**
Faculty	:	**Dr. Justin Raj C**	Class number	:	**CH2023241700061**
		Dr. Karthikeyan S			**CH2023241700069**
		Dr. Ramkumar M C			**CH2023241700063**
		Dr. Rajasekarakumar V			**CH2023241700067**
		Dr. Parasuraman E			**CH2023241700071**
		Dr. Divya Bharathi K			**CH2023241700059**
		Prof. Rishab Antosh B			**CH2023241700065**
Time	:	**90 minutes**	Max. Marks	:	**50**

Answer any FIVE Questions only (5 × 10 = 50)

Q.No	Questions	Mark
1	A rope of length 5 m and mass of 100 g is tied tightly between two rigid supports on the terrace. A crow perturbs the rope at its center and a transverse displacement was developed in the rope as given by the following equation, $$y(x,t) = 0.2 \sin\left(\frac{2\pi x}{3}\right)\cos(40\pi t)$$ where x and y are in meters and t in seconds. Answer the following i) Write down the equation of the individual waves that gives rise to the above stationary wave. ii) Determine the wavelength, frequency and speed of each wave. iii) Evaluate the tension in the string.	10
2	With the neat sketch and assumptions derive an equation for transverse wave motion in a stretched string with constant tension 'T'.	1
3	i) With a neat diagram, write down the equation of incidence, reflection and transmission waves of two dissimilar strings having linear densities ρ_1 and ρ_2 attached at a common boundary (x=0). Also give the reflection and transmission coefficient of the amplitudes in terms of impedance. ii) Prove that $y = A\cos(9\pi t - 8x)$ is a valid wave equation in string vibration.	1
4	i) A temperature gradient will occur after turning on an air heater in the closed room. If temperature distribution is given by the scalar function $T = 2xy^2z^3$, Calculate the change in temperature at a point (1, -2, 1). What will be the direction of maximum change in temperature in the room? ii) If $\vec{A} = x^2 y z\,\hat{x} + 3y^2\,\hat{y} - x z\,\hat{z}$, find $\vec{\nabla} \times \vec{A}$	10
5	Deduce the electromagnetic wave equation in a free space in terms of electric field vector $\vec{E}$ and calculate the velocity of the EM wave.	10
6	i) State and interpret the differential form of Gauss's law of electric and magnetic field. ii) State Ampere's law and explain when it is inconsistent? How did Maxwell modify it? Explain in detail.	10

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Continuous Assessment Test I – September 2023

Programme	:	**B.Tech**	Semester	:	**Fall Weekend Intra-2023-2024**
Course	:	**Engineering Physics**	Code	:	**BPHY101L**
Faculty	:	**Dr. E. Parasuraman**	Slot Class Number	:	**W21+W22+Z21** **CH2023240101894**
Time	:	**1½ Hours**	Max. Marks	:	**50**

Answer any FIVE Questions (5 × 10 = 50)

1.	a	The equation of transverse wave in a string is given by $y=10 \sin \pi(0.01\ x-2t)$. Find the frequency of the wave.	2
	b	Why equation of motion is important? Derive the equation of wave in a string.	8
2	a	A frequency of 550 Hz produces a wave of 44 cm wavelength in a string. Calculate the velocity of wave in a string.	4
	b	Show that the solution $y=A \cos(\omega t-k x)$ is satisfying the wave equation for a string	6
3		Obtain eigen frequency of wave generated on a string of length "L". Draw wave diagram for first three eigen frequencies	10
4	a	Show that grad $r^n = nr^{n-2}$ **r**.	5
	b	Show that Curl **r** = 0.	5
5	a	Write the physical significance of Maxwell's equation.	6
5	b	How equation of continuity help in modifying fourth Maxwell's equation? Explain.	4
6	a	Write the physical interpretation for the solution of plane electromagnetic wave propagation in free space.	3
	b	Obtain equation of electromagnetic wave propagating in free space.	7