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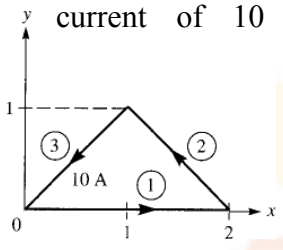
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, Dec-2017

Program Name: B. Tech- CS (CCVT, OGI, Big Data, OSS) **Semester – I**

Course Name : Physics **Max. Marks : 100**
Course Code : PHYS 1002 **Duration : 3 Hrs**
No. of page/s: 2

Instructions:
All questions are compulsory.
Question numbers to be written very clearly.
All highlighted representations are vectors.

	SECTION A (All parts are compulsory)		
1.	Convert point (1, 4, -3) to spherical coordinates.	**[4]**	**CO2**
2.	State and explain Faraday's law.	**[4]**	**CO3**
3.	Calculate, Plot and analyze Galilean velocity addition (u_g) and relativistic velocity addition (u_r) in terms of c v/s u', for given u' = 0.25c, 0.5c, 0.75c and c, when v = 0.75c, where *c* is the velocity of light.	**[4]**	**CO4**
4.	Deduce an expression for the numerical aperture of a given optical fiber.	**[4]**	**CO1**
5.	Obtain the relation between group velocity and phase velocity.	**[4]**	**CO5**
	SECTION B (Question 9 has internal choice)		
6 (a)	As determined by O′, a lightning bolt strikes at x′=60m, y′=z′=0 and t′=8×10^{-8} s. O′ has a velocity of 0.6c along x-axis of O. What are the space-time co-ordinates of the strike as determined by O?	**[5]**	**CO4**
6 (b)	The refractive indices of core and cladding of a optical fiber are 1.465 and 1.460, respectively and the light of wavelength 1.25μm is used. What should be the diameter of core for single mode propagation? If the core diameter is given as 50 μm, how many modes can propagate through the fiber?	**[5]**	**CO2**
7. (a)	The conducting triangular loop in the given figure carries a current of 10 A. Find **H** at (0, 0, 5) due to the side 1 of the loop. 	**[5]**	**CO3**
7. (b)	At what temperature, the ratio of spontaneous and stimulated coefficients are equal. Assume the wavelength to be 5000 Å.	**[5]**	**CO1**
8	Derive an expression for Compton shift. Why is the Compton effect not observed with visible light?	**[8+2]**	**CO5**
9	(a) Explain the construction process involved in the development of a hologram.	**[5]**	**CO1**

	(b) Plane z = 0 and z = 4 carry current $K=-10a_x A/m$ and $K=10a_x A/m$, respectively. Determine **H** at (a) (1, 1, 1) and (b) (0, -3, 10). **OR** (a) Describe the working of a Ruby Laser by drawing the energy level diagram. (b) A circular loop located on $x^2+y^2=9$, $z=0$ carries a direct current of 10 A along $a_\varnothing$ **.** Determine **H** at (0, 0, 4) and (0, 0, -4).	[5] **[5]** **[5]**	**CO3** **CO1** **CO3**
	SECTION C (Question 11 has internal choice)		
10 (a)	What are boundary conditions? Show that the tangential component of electric field is continuous and the normal component of electric displacement is discontinuous when charge density at surface i.e. $\rho_s \neq 0$.	**[2+8]**	**CO2**
10 (b)	The uncertainty in the momentum Δp of a football thrown by Tom during the superbowl traveling at $40 m/s$ is 1×10^{-6} of its momentum. Given Mass = 0.40kg. There is 2 mL of water traveling on the football at the same speed and Δp. Calculate its Δx.	**[10]**	**CO1**
11 a	(a) The density of gold is 19.3×10^3 kg/m^3 in a frame S that is at rest. Calculate its density that an observer in frame S′ would determine if the frame S′ is moving along the X-axis with a speed 0.9c. (b) Derive the Schrodinger's wave equation in time independent form. Explain physical significance of the wave function **OR** **(a)** An airplane is moving with respect to the earth with a speed of 600 m/s. As determine by earth clocks, how long will it take the airplanes clock to fall behind by two microseconds? **(b)** An electron is trapped in a one-dimensional potential box; obtain the expression for the Energy and wave function.	**[10]** **[10]** **[10]** **[10]**	**CO4** **CO5** **CO4** **CO5**
	Values of constants: **Constant** | **Standard Values** Planck's Constant (h) | 6.63×10^{-34} Joule-sec Permittivity of free space (ε_o) | 8.854×10^{-12} Farad/meter Velocity of Light c | 3×10^8 m/sec Boltzmann constant (k_B) | 1.38×10^{-23} J K^{-1} Rest mass of an Electron | 9.11×10^{-31} Kg Charge of electron | 1.6×10^{-19} C		

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Program/Course	:	**BTECH-(CIT)**						
Semester	:	**I**						
Name of the Subject	:	**PHYSICS**						
Subject Code	:	**PHYS 1002**						
Name of Question Paper Setter	:	**Dr. GAGAN ANAND AND Dr. SATYA KRISHNA NIPPANI**						
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Instructions:
All questions are compulsory.
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	SECTION A (All parts are compulsory)		
1.	Convert point (1, 4, -3) to cylindrical coordinates.	**[4]**	**CO2**
2.	State and explain Ampere's Circuit law.	**[4]**	**CO3**
3.	Plot a variation of ϒ = ¿ Vs (v/c) for the given values of v. Analyze how ϒ depends upon the velocity v. Given v = 0, $6*10^7$, $1.2*10^8$, $1.8*10^8$, $2.4*10^8$, $3*10^8$ m/s.	**[4]**	**CO4**
4.	A clock keeps correct time. At what speed should the clock move relative to an observer to lose four minutes in day?	**[4]**	**CO4**
5.	Explain pair production and pair annihilation.	**[4]**	**CO5**
	SECTION B (Question 9 has internal choice)		
6	Derive Einstein's coefficient for absorption, spontaneous emission and stimulated emission. Obtain the relation between them.	**[10]**	**CO1**
7.	Prove that for a relativistic particle group velocity (v_g) is equal to the particle velocity (v).	**[10]**	**CO3**
8.	Explain Bio-Savart's law. Apply Biot-Savart's law to determine the field due to a straight current carrying filamentary conductor of finite length AB.	**[8+2]**	**CO5**
9	(c) Explain the propagation mechanism in different types of optical fibers. (d) Determine the divergence of the following vector fields: **(i)** $P=x^2 y z a_x+x z a_z$ **(ii)** $Q=\rho \sin\varnothing a_\rho+\rho^2 z a_\varnothing+z\cos\varnothing a_z$ **OR** (c) Draw and compare the energy level diagram of ruby laser and He-Ne laser. (d) A homogeneous dielectric ($\epsilon_r = 2.5$) fills region 1 (x < 0) while region 2 (x > 0) is free space. (a) If $D_1=12a_x-10a_y+4a_z nC/m^2$, find $\mathbf{D_2}$ and θ_2.	**[5]** **[5]** **[5]** **[5]**	**CO1** **CO2** **CO1** **CO2**
	SECTION C (Question 11 has internal choice)		
10 (a)	Deduce the continuity equation and relaxation time.	**[6+4]**	**CO2**

10 (b)	Deduce an expression for kinetic energy (KE_{max}) of the recoil electron. Show that a photon of energy E is scattered by an electron initially at rest (rest mass energy, E_0) Show that the maximum kinetic energy (KE_{max}) of the recoil electron can be calculated as $KE_{max} = (2E^2/ E_0)/ (1+ 2E /E_0)$.	**[10]**	**CO1**
12 a	**(c)** An observer O′ holds 1.00 m stick at an angle of 30° with respect to the positive X′-axis. O′ moving in the positive X-X′ direction with a velocity 0.8c with respect to the observer O. What are the length and the angle of the stick as measured by observer O.	**[10]**	**CO4**
	(d) Derive the Schrodinger's wave equation in time dependent form. Explain properties of the wave function.	**[10]**	**CO5**
	OR		
	(a) A spaceship moving away from the earth with velocity 0.6 *c* fires a rocket whose velocity relative to spaceship is 0.7 *c* (i) away from the earth (ii) towards the earth. What will the velocity of the rocket be as observed from the earth in both the cases?	**[10]**	**CO4**
	(b) Derive Heisenberg's uncertainty principle and explain the non-existence of an electron inside the nucleus.	**[10]**	**CO5**

Values of constants:

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule-sec
Permittivity of free space (ε_o)	8.854×10^{-12} Farad/meter
Velocity of Light c	3×10^{8} m/sec
Boltzmann constant (k_B)	1.38×10^{-23} J K^{-1}
Rest mass of an Electron	9.11×10^{-31} Kg
Charge of electron	1.6×10^{-19} C