BACHELOR OF COMPUTER SCIENCE & ENGINEERING
EXAMINATION 2015
(1^{st} year, 1^{st} Semester)
PHYSICS I

Time : Three hours

Full Marks: 100

Answer any three from group A and any two from group B

Group A

1. (a) Discuss the microscopic definition of an ideal gas. Show, from kinetic theory of gas, that the internal energy of an ideal gas is a function of temperature only. Describe the concept of equipartition of energy in the light of kinetic theory of gas. 3 + 7 + 2

   (b) Assuming that the speed of sound in a gas is the same as the root mean square speed of the molecules. Show how the speed of the sound for an ideal gas depends on the temperature. 5

   (c) Explain why the specific heat at constant pressure is greater than the specific heat at constant volume. 3

2. (a) Calculate the work done in compressing 1 mole of oxygen from a volume of 22.4 litres at 0^0C and 1 atm pressure to 16.8 litres at the same temperature. 5

   (b) Propagation of sound wave at audio frequency is practically adiabatic. Show that speed of sound in an ideal gas is given by $v = \sqrt{\frac{\gamma P}{\rho}}$, where ρ is the gas density, γ is the constant of adiabatic process = 1.40. P is the pressure. 5

   (c) Maxwell's molecular speed distribution for a sample of gas containing N molecules is given by

   $$N(v)dv = 4\pi N(\frac{m}{2\pi KT})^{\frac{3}{2}} v^2 e^{\frac{-mv^2}{2KT}} dv \qquad (1)$$

   Where symbols have their usual meaning. Calculate the average speed $\bar{v}$, r.m.s speed v_{rms} and most probable speed v_p of the molecules. Draw the distribution curve at two different temperatures indicating $\bar{v}$, v_{rms} and v_p. ($\int_0^\infty x^2 e^{-ax^2} dx = \frac{1}{4}\sqrt{\frac{\pi}{a^3}}$; $\int_0^\infty x^3 e^{-ax^2} dx = \frac{1}{2a^2}$; $\int_0^\infty x^4 e^{-ax^2} dx = \frac{3}{8}\sqrt{\frac{\pi}{a^5}}$) 8+2.

3. Discuss the physical significance of the van der Waals constants. Draw the isotherms from van der Waals equation of state. Indicate the unphysical region of these isotherms and also indicate the critical point. Derive the expression for critical constants in terms of van der Waal constants. Hence derive the universal equation of state. What is law of corresponding state? 3 + 3 + 6 + 6 + 2

4. (a) Explain Carnot's cycle on a P-V diagram for an ideal gas and calculate its efficiency. Differentiate between a refrigerator and a heat pump. 10 + 3

   (b) Explain how one arrives at the idea of entropy as a state function. 2

(c) Two Carnot engines A and B are operated in series. A receives heat at 900^o K and rejects at T° K. B receives heat rejected by A and in turn rejects at 400^o K. Calculate the value of T when (i) the work outputs of A and B are equal, and (ii) the efficiencies of A and B are equal. 5

5. (a) What do you mean by International Practical Temperature scale? 3

(b) First and second law of thermodynamics together provide the internal energy as $dU = TdS - PdV$. Hence obtain the expression for Gibbs and Helmholtz free energies and also the enthalpy the system 5

(c) Derive the Maxwell's thermodynamic relations. Using Maxwell's relation show that the ratio of adiabatic to isothermal elasticity (bulk modulus) is γ, the ratio of two specific heats ($\frac{C_P}{C_V}$). 8+ 4

Group B

6. (a) What are the limitations of Rutherfords atom model? Write down Bohrs postulates. Calculate the energy vales of different orbits of Hydrogen atom according to Bohrs theory. 3 + 2 + 6

(b) Compton wavelength gives the scale of the wavelength change of the incident photon in Compton effect-Explain. 3

(c) X-rays of wavelength 10.0 pm are scattered from a target. Find the (i) wavelength of the x-rays scattered through 45^o, (ii) maximum wavelength present in the scattered x-rays, (iii) maximum kinetic energy of the recoil electrons. 6

7. (a) Explain the origin of continuous and characteristic X-ray spectra. Show that Moseleys law is consistent with Bohrs theory of atomic spectra. What is the importance of Moseleys law? Can you consider characteristic X-ray production as inverse photoelectric effect? 4 + 5 + 2 + 2

(b) Electrons are accelerated by 30 kV supply in an X-ray tube. Find the maximum speed of electron and the minimum wavelength in the continuous X-ray spectrum produced by the tube. 4

(c) The Bragg angle corresponding to the first order reflection from (111) planes in a crystal is 30^o when X-rays of wavelengths 1.74 Å are used. Calculate the inter-atomic spacing. 3

8. (a) State Heisenberg uncertainty principle and discuss its significance. 3

(b) Typical radius of atomic nucleus is about 10^{-15} m. Using Heisenberg uncertainty relation show that an electron cannot exist in the nucleus of an atom. 4

(c) Explain the concept of wave particle duality 3

(d) Calculate the de Broglie wavelength of a (i) 1 gm ball with velocity 1m/s and that of (ii) an electron with velocity of 107 m/s. 4

(e) Explain the significance of wave function. A particle limited to the x axis has the wave function $\psi = ax$ between $x = 0$ and $x = 1$; $\psi = 0$ elsewhere. (i) Find the probability that the particle can be found between $x = 0.45$ and $x = 0.55$. (ii) Find the expectation value $< x >$ of the particles position. 2 + 4

Ex./CSE/Math/T/113/19/2015

B. CSE Examination, 2015

(1st Year, Ist Semester)

MATHEMATICS

Paper - I

Time : Three Hours

Full Marks : 100

The figures in the margin indicate full marks.

Answer Q. No. 9 and any *six* from Q. No. 1 - 8.

1. (a) Let A, B, C, D be subsets of a set X. Prove that

$$(A \times C) \setminus (B \times D) = \{(A \setminus B) \times (C \setminus D)\} \cup \{(A \cap B) \times (C \setminus D)\} \cup \{(A \setminus B) \times (C \cap D)\}.$$

(b) Define an equivalence relation ρ on a non-empty set S. Examine whether ρ is an equivalence relation on S in the following cases:

(i) $S = \mathbb{Z} \times \mathbb{Z}$ and $(a,b)\rho(c,d) \iff a+d = b+c$.

(ii) $S = (\mathbb{Z} \times \mathbb{Z}) \setminus \{(0,0)\}$ and $(a,b)\rho(c,d) \iff ad = bc$. 8 + 8

2. (a) When is a function called left invertible? Let A, B be two non-empty sets and $f : A \longrightarrow B$ be a function from A into B. Show that f is left invertible if and only if f is injective.

(b) Let β be a permutation on the set $\{1, 2, \ldots, 7\}$ such that $\beta^4 = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 4 & 1 & 5 & 3 & 6 & 7 & 2 \end{pmatrix}$, then find β. 8 + 8

3. (a) Define a finite set and an infinite set. Let A be a finite set and B be an infinite set. Show that $|A \cup B| = |B|$.

(b) Define a countable set and an uncountable set with examples. Let A be the set of all sequences whose elements are the digits 0 and 1. Determine whether A is countable or uncountable. 8 + 8

4. (a) Define the order completeness property and the least upper bound property of a totally ordered set. Show that these two properties are equivalent in the set of real numbers $\mathbb{R}$.

(b) Define limit points of a subset S of $\mathbb{R}$. Find limit points of the following subsets S of $\mathbb{R}$:

(i) the set of natural numbers $\mathbb{N}$, (ii) the set of rational numbers $\mathbb{Q}$, (iii) $\{(-1)^n(\frac{1}{4} - \frac{8}{n}) \mid n \in \mathbb{N}\}$. 8 + 8

5. (a) A line makes angles $\alpha, \beta, \gamma, \delta$ respectively with the four diagonals of a cube; show that

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta = \frac{4}{3}.$$

(b) Show that the planes $x + 2y + 2z = 0$ and $2x + y - 2z = 0$ are orthogonal. Find another plane passing through the origin such that it is perpendicular to each of the above planes. 3+3

6. (a) Find the shortest distance between the straight lines

$$\frac{x-3}{-3} = \frac{y-8}{1} = \frac{z-3}{-1} \quad \text{and} \quad \frac{x+3}{3} = \frac{y+7}{-2} = \frac{z-6}{-4}.$$

Also find the equation of the line of shortest distance.

(b) Find the equation of the sphere which has $(3,4,-1)$ and $(-1,2,3)$ as the ends of a diameter, and also find its center and radius. 5+3

7. (a) Find the equation of the cone whose vertex is at $(1,2,3)$ and the guiding curve is the circle $x^2 + y^2 + z^2 = 9,\ x + y + z = 1$.

(b) Find the equation of the cylinder whose generating line is parallel to the z-axis and the guiding curve is given by $x^2 + y^2 - z = 0,\ x + y + z = 1$. 5+3

8. (a) If the volume of a tetrahedron be 2 units and three of its vertices be $(1,1,0), (1,0,1)$ and $(2,-1,1)$, then find the locus of the fourth vertex.

(b) Find the torque about the point $(3,-1,3)$ of a force $(4\mathbf{i} + 2\mathbf{j} + \mathbf{k})$ passing through the point $(5,2,4)$. 5+5

9. What is the remainder when $1! + 2! + 3! + \cdots + 99! + 100!$ is divided by 18? 4

Full Marks:

Ex./CSE/MATH/T/114A/2016

BACHELOR OF COMPUTER SC. ENGINEERING EXAMINATION 2016

(1st Year, 1st Semester)

Mathematics - II

Time : Three hours

Full Marks : 100

Answer any ***five*** questions.

1. (a) Define bounded sequence.

If $x_n = \frac{3n-1}{n+2}$, prove that $\{x_n\}$ is monotonically increasing and bounded. 8

(b) Show that the limit of a convergent sequence is unique. 6

(c) Prove that the sequence $\{x_n\}$ where $x_n = \frac{1}{n+1} + \frac{1}{n+2} + \ldots + \frac{1}{2n}$ is a convergent sequence. Estimate its limit. 6

2. (a) State Cauchy's general principle of convergence of an infinite series. Prove that if $u_n > 0$ and if $\lim_{n\to\infty} (u_n)^{\frac{1}{n}} = \rho$ then

(i) $\sum u_n$ converges if $\rho < 1$

(ii) diverges if $\rho > 1$ 8

(Turn Over)

(b) Determine the radius of convergence and interval of convergence. 12

(i) $\sum \frac{(x-1)^n}{2^n}$

(ii) $x+\frac{(2!)^2}{4!}x^2+\frac{(3!)^2}{6!}x^3+....+\frac{(n!)^2}{(2n)!}x^n+....$

3. (a) Show that the function

$$f(x,y)=\begin{cases} xy\dfrac{x^2-y^2}{x^2+y^2}, & x^2+y^2\neq 0 \\ 0, & x=0=y \end{cases}$$

is continuous at (0,0). 8

(b) If $f(x,y)=\sqrt{|xy|}$, find $f_x(0,0)$, $f_y(0,0)$. 6

(c) If $z=e^{xy^2}$, $x=t\cos t$, $y=t\sin t$,

compute $\frac{dz}{dt}$ at $t=\frac{\pi}{2}$. 6

4. (a) State and prove Leibnitz's theorem of nth derivative of the product of two functions. 8

(b) Find the value of y_n for $x=0$ when $y=e^{a\sin^{-1}x}$. 8

(c) Show that

$$\frac{x}{1+x} < \log(1+x) < x, \text{ if } x < 0$$ 4

5. (a) Prove that a bounded function f(x), having a finite number of points of discontinuity on [a,b] is integrable on [a,b]. 8

(b) Prove that the function f(x) defined as

$$f(x) = \begin{cases} x, \text{when } x \text{ is rational} \\ -x, \text{when } x \text{ is irrational} \end{cases}$$

is not integrable over [a,b], but |f| is integrable. 7

(c) Compute the value of the integral $\int_0^1 x^2 dx$ by Riemann integral theory. 5

6. (a) Test the convergency of the following

(i) $\int_0^{\pi/2} \log \sin x \, dx$ (ii) $\int_0^{\infty} \frac{\sin x}{x} dx$ 6+4

(b) Evaluate :

(i) $\lim_{x \to 0} \left(\frac{\sin x}{x} \right)^{\frac{1}{x^2}}$ (ii) $\lim_{x \to 0} \left(\frac{x - \sin x}{x^3} \right)$ 6

Full Marks: 100

(c) Using the definition of Beta function,

prove that $\int_0^{\pi/2} \cos^4 x \, dx = \frac{3\pi}{16}$ 4

7. (a) Find the area common to the cardioide

$r = a(1+\cos\theta)$ and the circle $r = \frac{3}{2}a$. 6

(b) Show that in the cycloid $x = a(\theta+\sin\theta)$, $y = a(1-\cos\theta)$,

$$\rho^2 + s^2 = 16a^2,$$

where the arc 's' being measured from the vertex ($\theta=0$) and ρ is the radius of curvature at any point. 6

(c) The part of the parabola $y^2 = 4ax$ bounded by the latus rectum revolves about the tangent at the vertex. Find the volume and the area of the curved surface of the reel thus generated. 8

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Ex/HUM/T/A/2016

BACHELOR OF ENGINEERING EXAMINATION, 2016

(1st Year, 1st Semester)

HUMANITIES / HUMANITIES A

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a separate Answer-Script for each part

PART- I

(ENGLISH)

1. Answer *any one* of the following questions: 15

a. What role, if any, does Watson play in Sherlock Holmes's 'The Adventures of the Blue Carbuncle'?

b. Who, in your opinion, is the better friend- Bob or Jimmy- in O'Henry's short story 'After Twenty Years'?

c. Why and how does Nandu in 'The Barbers' Trade Union' voice his protest against the village elders?

2. Answer *any one* of the following questions: 15

a. You have been appointed as a student member of a fact-finding committee set up to look into complaints about ragging made by the first year students against their seniors at the college where you study. Write a report addressed to the Principal, South West District College giving details of your findings and suggestions for preventing such incidents in the future.

Or

b. A reputed nationalised bank is recruiting probationary officers. Candidates must possess a bachelor's degree in any stream from an institution recognised by the government. Apply with certificates and testimonials to ABC Bank, 5, Mayfair Road, Mumbai-22.
Respond to the above advertisement with a CV and job application letter.

3. Make sentences with *any five* of the following words: 5x2=10

plodder, scintillating, drizzling, vicinity, destiny, ordeal, labyrinth, sheen, defiled, solemnly

[Turn over

Time : 3 Hr

estions : Q1 (Compulsory) and any four from the rest.
and state all the assumptions (wherever required).
ANSWERED TOGETHER

2×10

4. Read the passage carefully and answer the following questions:

This was very uncomfortable, and I was half afraid. However, the only thing to be done being to knock at the door, I knocked, and was told from within to enter. I entered, therefore, and found myself in a pretty large room, well lighted with wax candles. No glimpse of daylight was to be seen in it. It was a dressing-room, as I supposed from the furniture, though much of it was of forms and uses then quite unknown to me. But prominent in it was a draped table with a gilded looking-glass, and that I made out at first sight to be a fine lady's dressing-table.

Whether I should have made out this object so soon if there had been no fine lady sitting at it, I cannot say. In an arm-chair, with an elbow resting on the table and her head leaning on that hand, sat the strangest lady I have ever seen, or shall ever see.

She was dressed in rich materials,—satins, and lace, and silks,—all of white. Her shoes were white. And she had a long white veil dependent from her hair, and she had bridal flowers in her hair, but her hair was white. Some bright jewels sparkled on her neck and on her hands, and some other jewels lay sparkling on the table. Dresses, less splendid than the dress she wore, and half-packed trunks, were scattered about. She had not quite finished dressing, for she had but one shoe on,—the other was on the table near her hand,—her veil was but half arranged, her watch and chain were not put on, and some lace for her bosom lay with those trinkets, and with her handkerchief, and gloves, and some flowers, and a Prayer-Book all confusedly heaped about the looking-glass.

a. How does the narrator deduce that the room he entered was a dressing-room? (2)

b. Why does the narrator think the lady to be strange? (2)

c. Which details give an impression that the lady had not quite finished dressing? (4)

d. Give the meanings of: gilded, sparkling (2)

Ref.no:EX/HUM/T/A/2016

B.E 1ST YEAR, 1ST SEMESTER, EXAMINATION-2016

HUMANITIES / HUMANITIES A

SOCIOLOGY

Part II

FULL MARKS -50

1. Write short notes of any *four* of the followings- 5x4

a. Sociology and political science
b. Sociological perspective
c. Micro analysis
d. Internal environment of an organization
e. Foreign direct investment
f. Conflict theory
g. Joint ventures
h. Concept of economic growth

2. Attempt any two of the followings- 15

a. How is sociology related to other sciences? 5+10
b. What is a theoretical perspective in Sociology? Write a note on symbolic interactionism. 15
c. Discuss the contribution of information and communications technology (ICTs) in improving the quality of life for citizens. 5+10
d. What is an organization? What are its basic traits and elements?

Ref. No.: EX/CSE/T/115A/2016

B.C.S.E. 1st Year, 1st Semester Examination, 2016
Digital Logic

Time : 3 Hr

Full Marks: 100

Answer Five Questions : Q1 (Compulsory) and any four from the rest.
Write answers to the point and state all the assumptions (wherever required).
Make assumptions wherever necessary.
ALL PARTS OF THE QUESTION SHOULD BE ANSWERED TOGETHER

2×10

Q 1) Answer all questions. Choose the right option Only give the option:

(a) If a 3-input NOR gate has eight input possibilities, how many of those possibilities will result in a HIGH output?

A. 1
B. 2
C. 7
D. 8

(b) Give the decimal value of $(10010)_2$.

A. 6_{10}
B. 9_{10}
C. 18_{10}
D. 20_{10}

(c) How many binary bits are necessary to represent 748 different numbers?

A. 9
B. 7
C. 10
D. 8

(d) In a 6-bit Johnson counter sequence there are a total of how many states, or bit patterns?

A. 2
B. 6
C. 12
D. 24

(e) The simplification of the Boolean expression $(\overline{\overline{A}B\overline{C}}) + (\overline{A\overline{B}C})$ is

A. 0
B. 1
C. A
D. BC

(f) The code where all successive numbers differ from their preceding number by single bit is

A. Binary code
B. BCD
C. Excess-3
D. Gray

(g) -8 is equal to signed binary number

A. 10001000
B. 00001000
C. 10000000
D. 11000000

(h) A device which converts BCD to Seven Segment is called

A. Encoder
B. Decoder
C. Multiplexer
D. Demultiplexer

(i) When signed numbers are used in binary arithmetic, then which one of the following notations would have unique representation for zero.

A. Sign-magnitude.
B. 1's complement.
C. 2's complement.
D. 9's complement.

(j) How many flip flops are required to construct a decade counter

A. 10
B. 3
C. 4
D. 2

Q 2) (a) Simplify $(3 \times 5 = 15)$

(i) $F = \overline{A}(\overline{B} + \overline{C}) + B.C + A.\overline{C}$

(ii) $F = \overline{A(B + C)} + \overline{A}B + \overline{C}.\overline{(A + B)}$

(iii) $F = \overline{\overline{C}.\overline{B}.\overline{A} + C.B.\overline{A}}$

(b) Explain the operation of a JK flip-flop. How does it differ from an RS flip-flop? $(3 + 2 = 5)$

Q 3) (a) Design OR-AND and NOR logic circuits for the Boolean expression $(2 + 5 = 5)$

$$Y = \overline{A}.(B + C).D$$

(b) What is De-Morgan's theorem. Solve using this theorem the following $(2 + 3 = 5)$

$$(A + B).(C + D) = \overline{\overline{(A + B)} + \overline{(C + D)}}$$

(c) Design a combinatorial logic system which compares a pair of 3-bit binary number. For each pair of bits, there should be three functions, $F_{Equal} := A = B$, $F_{Greater} := A > B$ and $F_{Small} := A < B$, where $A \equiv A_0A_1A_2$ and $B \equiv B_0B_1B_2$ (10)

Q 4) (a) Represent $(50)_{10}$ in binary form using : $(2 \times 3 = 6)$
(i) BCD Code (ii) Excess-3 Code (iii) Gray Code

(b) What are universal gates? Realize NOT, OR, NOR, AND, NAND and XOR with the universal gates. $(1 + 5 = 6)$

(c) Explain the working of a Master-Slave J-K flip-flop (3)

(d) Design and explain with a clock diagram the working of an asynchronous 2-Bit Binary Counter. (5)

Q 5) (a) (i) Convert the following 29_{16} to binary. Show each step clearly. (2)
(ii) Perform the following: $411 - 332$ using 9's complement Binary Coded Decimal (BCD) subtraction. (3)

(b) Design the full subtractor using NAND gates only. (5)

(c) Realise the function with the help of NAND gates: (5)

$$f(A, B, C, D) = \Sigma(0, 1, 4, 6, 9, 12, 15) + \phi(2, 3, 6)$$

(d) Explain the working of bi-directional shift registers. (5)

Q 6) (a) Demonstrate that the following propositions are logically equivalent: (2.5)
$p \vee (q \wedge r)$ and $(p \vee q) \wedge (p \vee r)$

(b) Find the DNF and CNF of the following expression: $(A \vee B) \wedge (\neg B \vee C)$ (2.5)

(c) What is a synchoronous and asynchronous counters. Give examples with clock diagrams. (5)

(d) Design a MOD-10 Synchronous counter. Give the clock diagram of the sequence (10)

Q 7) (a) Solve the following using Quine-McCluskey Method (10)

$$F(A, B, C, D) = \Sigma(2, 3, 7, 9, 11, 13) + \Sigma\phi(1, 10, 15)$$

(b) Draw a logic diagram of a mod-12 ripple up counter by using four JK flip-flops (with clear inputs) and a 2-input NAND gate. Explain with clock diagrams. (5)

(c) Write a short note on Multiplexers and Demultiplexers (5)