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Seat No.	
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F. E. (Semester – II) Examination, 2014
APPLIED SCIENCE – II (Physics)
(Old) (2008 Course)

Time : 2 Hours

Max. Marks : 50

- Instructions :** 1) Answer **any three** questions (Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6)
2) Figures to the **right** indicate **full** marks.
3) Neat diagrams must be drawn **wherever** necessary.
4) **Use** of electronic calculator is **allowed**.
5) Assume suitable data **if** necessary.

- Constants :**
- 1) Mass of electron (m_e) = 9.1×10^{-31} kg.
 - 2) Charge on electron (e) = 1.9×10^{-19} C
 - 3) Mass of neutron (m_n) = 1.675×10^{-27} kg.
 - 4) Planck's Constant (h) = 6.63×10^{-34} J.s
 - 5) Velocity of light in vacuum (c) = 3×10^8 m/s.

- 1. a) State and explain Heisenberg's Uncertainty Principle. Illustrate this principle with an experiment on diffraction of electrons. 7
b) Derive Schrodinger's time independent equation. 6
c) Calculate the de-Broglie wavelength associated with 1 Mev neutron. 4
OR
- 2. a) Derive equation of energy and wave function when a free particle is trapped in an infinite potential well. 7
b) Explain the concept of group velocity. Show that group velocity is equal to the velocity of the particle. 6
c) Calculate energy level difference between first two excited state of a neutron trapped in infinite potential well of width 10^{-15} m. 4
- 3. a) With the help of energy level diagram explain construction and working of He-Ne laser. 6
b) What is Critical Magnetic Field ? Explain Type-I and Type-II superconductors. 6
c) Explain for laser (a) Stimulate emission of radiation (b) Pumping. 4
OR
- 4. a) What is superconductivity ? Explain BCS theory of superconductivity. 6
b) With the help of energy level diagram explain construction and working of Ruby laser. 6
c) Explain for superconductor (a) Transition temperature (b) Persistent current. 4

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5. a) What is band gap energy ? Explain classification of solids into conductors, semiconductors and insulators on the basis of band theory of solids. 7
- b) What are the different methods for synthesis of nanoparticles ? Explain any one method in details. 6
- c) A strip of copper of thickness 1.5×10^{-4} m is placed in a magnetic field of 1 T perpendicular to the plane of the strip and a current of 10 A is setup in the strip. What Hall voltage would appear across the width of the strip if concentration of charge carries in copper is 8.5×10^{28} electrons/m³. 4

OR

6. a) Explain the construction and working of solar cell. Explain its IV characteristics. 7
- b) Explain any two properties of nanoparticles. 6
- c) A germanium sample has 4.56×10^{22} atoms/cc and a donor impurity in the ratio of one part per 10^{10} is added to create an N type semiconductor. If the mobility of charge carries is $3900 \text{ cm}^2/\text{V-s}$, find the conductivity of silicon. 4



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**F.E. (Semester – II) Examination, 2014
ENGINEERING MATHEMATICS – II (Old)
(2008 Course)**

Time : 3 Hours

Max. Marks : 100

- Instructions :** 1) In Section – I solve Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6. In Section – II solve Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12.
2) Neat diagrams must be drawn **wherever** necessary.
3) Figures to the **right** indicate **full** marks.
4) **Use** of non-programmable electronic pocket calculator is **allowed**.
5) Assume suitable data, if **necessary**.

SECTION – I

1. a) Form the differential equation whose general solution is $y = c_1 e^x + c_2 e^{-x} + 3x$. 6

- b) Solve **any two** : 10

i) $\frac{dy}{dx} = \frac{x^2 + 2y^2}{xy}$

ii) $\frac{dy}{dx} + \frac{y \cos x + \sin y}{\sin x + x \cos y} = 0$

iii) $\frac{dy}{dx} - xy = -y^3 e^{-x^2}$

OR

2. a) Form the differential equation whose general solution is $y = (c_1 + c_2 t)e^t$. 6

- b) Solve **any two** : 10

i) $(e^y + 1)\cos x \, dx + e^y \sin x \, dy = 0$

ii) $\frac{dy}{dx} + \frac{y}{1-x} = x^2 - x$

iii) $\frac{dy}{dx} = \frac{x+y+3}{3x+3y-3}$

3. Solve **any three** : 18

- i) A body at temperature 90°C is placed in a room whose temperature is 30°C and cools to 50°C in 6 minutes. Find temperature after a further interval of 6 minutes.
ii) A resistance of $120\,\Omega$ and inductance of 0.6 henry are connected in series with battery 30 volts. Find current in a circuit as a function of t .

P.T.O.



- iii) Find the orthogonal trajectories of the curves given by $y = 4ax^2$.
- iv) A body start moving from rest is apposed by force per unit mass of value cx and resistance per unit mass of value bv^2 where x and v are displacement and velocity of particle at that instant, show that the velocity of particle is given by $v^2 = \frac{c}{2b^2}(1 - e^{-2bx}) - \frac{cx}{b}$.

OR

4. Solve **any three**.

18

- i) A pipe 10 cm in diameter contains steam at 100°C it is covered with asbestos 5 cm thick for which $k = 0.006$ and the outside temperature is at 30°C . Find the amount of heat lost per hour from a meter long pipe.
- ii) Radium decomposes at the rate proportional to the amount present. If 5% of the origin amount disappear in 50 years. How much remains after 75 years ?
- iii) Equation of L-R circuit is given by $L \frac{di}{dt} + Ri = 10 \sin t$
 $i = 0$ at $t = 0$, express i as function of t .
- iv) A metal ball is heated to a temperature of 100°C and at time $t = 0$ it is placed in water which is maintain at 50°C , if temperature of ball is reduced to 70°C in 5 minute. Find the time at which temperature of ball is 60°C .

5. a) Obtain the Fourier series for the periodic function

9

$$f(x) = \begin{cases} \sin x & 0 \leq x \leq \pi \\ 0 & \pi \leq x \leq 2\pi \end{cases}$$

Hence deduce that $\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \dots = \frac{1}{2}$

b) If $U_n = \int_0^{\pi/4} \sec^n \theta \, d\theta$, prove that $U_n = \frac{(\sqrt{2})^{n-2}}{n-1} + \frac{n-2}{n-1} U_{n-2}$, hence evaluate U_4 .

7

OR

6. a) Compute first two harmonics of the Fourier series of $f(x)$ given in the table

x	0	60°	120°	180°	240°	300°
$f(x)$	1	1.4	1.9	1.7	1.5	1.2

8

b) Evaluate $\int_0^\infty e^{-\sqrt{x}} x^{1/4} \, dx$.

4

c) Evaluate $\int_0^\infty \frac{x^4(1-x^2)}{(1+x)^{12}} \, dx$

4



SECTION – II

7. a) Trace the following curves (**any two**): 8
- i) $xy^2 = a^2 (a - x)$
 - ii) $r^2 = a^2 \cos 2\theta$
 - iii) $x = a(\theta - \sin \theta), y = a(1 - \cos \theta)$

b) Verify rule of DUIS for $I = \int_0^{\pi/2} e^{ax} dx$. 5

- c) Find the perimeter of the cardioid $r = a[1 + \cos \theta]$. 4

OR

8. a) Trace the following curves (**any two**): 8
- i) $x = a \cos^3 t, y = b \sin^3 t$
 - ii) $r = a \cos 3\theta$
 - iii) $y^2 (2a - x)x^3$

b) Show that $\int_0^\infty e^{-x^2 - 2bx} dx = \frac{\sqrt{\pi}}{2} e^{b^2} [1 - \operatorname{erf}(b)]$. 5

- c) Find the length of the arc of the curve $y = c \cosh \left[\frac{x}{c} \right]$ measured from the vertex to any point (x, y) and show that $s^2 = y^2 - c^2$. 4

9. a) Find the equation of the sphere which passes through the point $(3, 1, 2)$ and meets XOY-plane in a circle of radius 3 units with the centre at $(1, -2, 0)$. 6

- b) Find the semi-vertical angle and the equation of right circular cone having its vertex at the $(0, 0, 0)$ and passing through the circle $x^2 + z^2 = 25$ and $y = 4$. 5

- c) Find the equation of right circular cylinder whose axis is the line $2(x - 1) = y + 2 = z$ and radius is 2. 6

OR

10. a) Find the equation of the sphere for which the circle $x^2 + y^2 + z^2 + 7y - 2z + 2 = 0$, $2x + 3y + 4z = 8$ is a great circle. 6

- b) Obtain the equation of the right circular cone which passes through $(1, 3, 4)$ with vertex $(2, 2, 1)$ and axis parallel to the line $\frac{x+1}{2} = \frac{y-1}{-2} = \frac{z-2}{3}$. 6

- c) Find the equation of the right circular cylinder described on the circle through $(a, 0, 0)$, $(0, a, 0)$ $(0, 0, a)$. 5

11. Solve **any two**.

a) Evaluate $\int_0^{\sqrt{a^2 - y^2}} \left[\sin \frac{\pi}{a^2} (a^2 - x^2 - y^2) \right] dx dy$. 8



- b) Find the position of the centroid of the area bounded by the curve $y^2(2a - x) = x^2$ and the asymptote. 8

- c) Find the volume of the region enclosed by the cone $z = \sqrt{x^2 + y^2}$ and paraboloid $z = x^2 + y^2$. 8

OR

12. Solve **any two**.

- a) Find the area of the loop of the curve $a^4 y^2 = x^5 [2a - x]$. 8

- b) Evaluate $\iiint [x^2 y^2 + y^2 z^2 + z^2 x^2] dx dy dz$ throughout the volume of the sphere $x^2 + y^2 + z^2 = a^2$. 8

- c) Find the moment of inertia about the x-axis of the area enclosed by the lines $x = 0, \frac{x}{a} + \frac{y}{b} = 1$. 8



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F.E. (Semester – II) Examination, 2014
APPLIED SCIENCE – II (Chemistry)
(Old) (2008 Course)

Time : 2 Hours

Max. Marks : 50

Instructions : 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6.
2) **Neat** diagram must be drawn **wherever** necessary.
3) Figures to the **right** indicate **full** marks.
4) Assume suitable data, if **necessary**.

1. A) Define calorific value of fuel. How it can be determined using Bomb Calorimeter ? 7
B) Write a note on Bio-diesel, mentioning its preparation reaction, merits and demerits. 6
C) One gram coal sample was burnt in oxygen. Carbon dioxide was absorbed in KOH and water-vapour in CaCl_2 . The increase in weight of KOH and CaCl_2 was 2.05 and 0.55 gm respectively. Determine the % C and % H in the sample. 4
OR
2. A) Explain the process of refining of petroleum with diagram. Give composition, boiling range and use of any three fractions obtained. 7
B) Define the term knocking. Explain octane number and cetane number of fuel. 6
C) Volumetric analysis of producer gas is $\text{H}_2 = 25\%$, $\text{CO} = 20\%$, $\text{N}_2 = 40\%$, $\text{CH}_4 = 2\%$, $\text{CO}_2 = 13\%$.
Find the volume of air required for complete combustion of 1m^3 of gas. 4
3. A) What is electrochemical corrosion ? Explain its mechanism by hydrogen evolution and oxygen absorption. 7
B) Describe cathodic protection methods to prevent corrosion. 6
C) What is metallic coating ? Which coating is better anodic or cathodic ? Explain. 4
OR
4. A) Define corrosion. Explain dry corrosion due to oxygen. Explain with examples how nature of oxide film affects corrosion. 7
B) Discuss various factors affecting the rate of corrosion, w.r.t. nature of metal and environment. 6
C) Write a note on electroplating. 4

P.T.O.



5. A) What are scale and sludges ? Give their formation, disadvantage and preventive measures in boiler. 6
- B) State Gibb's phase rule. Define the terms involved in it with examples. 6
- C) 100 ml of water sample requires 4 ml of N/50 H_2SO_4 up to phenolphthalein end point and 20 ml for complete neutralization. Find the type and amount of alkalinity in the water sample. 4

OR

6. A) Draw and explain phase diagram of water system with respect to areas, curves and triple point. 6
- B) Explain the Zeolite method of water softening with figure, process, reaction and advantages. 6
- C) Write a note on caustic embrittlement. 4
