

02 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2071 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Mathematics II (SH451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. State Euler's theorem for a homogeneous function of two independent variables and verify it for the function $u = x^n \cdot \sin\left(\frac{y}{x}\right)$. [1+4]
2. Find the extreme value of $x^2 + y^2 + z^2$ subject to the condition $x + y + z = 1$ and $xyz + 1 = 0$. [5]
3. Evaluate $\iint xy(x+y)dx dy$ over the area between $y = x^2$ and $y = x$. [5]
4. Evaluate the integral by changing to polar coordinates $\int_0^1 \int_x^{\sqrt{2x-x^2}} (x^2 + y^2) dy dx$. [5]

OR

Find by triple integration the volume of sphere $x^2 + y^2 + z^2 = a^2$. [5]

5. Show that the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $4x - 3y + 1 = 0 = 5x - 3z + 2$ are coplanar. Also find their point of intersection. [5]
6. Find the length and equation of the shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $2x - 3y + 27 = 0, 2y - z + 20 = 0$. [5]
7. Find the centre and radius of the circle $x^2 + y^2 + z^2 - 8x + 4y + 8z - 45 = 0, x - 2y + 2z - 3 = 0$. [5]
8. Find the equation of right circular cone whose vertex at origin and axis the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ with the vertical angle 30° . [5]

OR

Find the equation of the right circular cylinder having for its base the circle $x^2 + y^2 + z^2 = 9, x - y + z = 3$. [5]

9. Solve by the power series method the differential equation $y'' - 4xy' + (4x^2 - 2)y = 0$. [5]
10. Test whether the solutions of $y''' - 2y'' - y' + 2y = 0$ are linearly independent or dependent. [5]

11. Show that: $J_{\left(\frac{5}{2}\right)}(x) = \sqrt{\frac{2}{\pi x}} \left(\frac{3}{x} \sin x + \frac{3-x^2}{x^2} \cos x \right)$ [5]

12. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{a}', \vec{b}', \vec{c}'$ are the reciprocal system of vectors, then prove that

$$\vec{a}' \times \vec{b}' + \vec{b}' \times \vec{c}' + \vec{c}' \times \vec{a}' = \frac{\vec{a} + \vec{b} + \vec{c}}{[\vec{a} \ \vec{b} \ \vec{c}]}, \quad [\vec{a} \ \vec{b} \ \vec{c}] \neq 0. \quad [5]$$

13. The necessary and sufficient condition for the function \vec{a} of scalar variable t to have a constant direction is $\vec{a} \times \frac{d\vec{a}}{dt} = 0$. [5]

14. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at the point $(1, -2, -1)$ in the direction of vector $2\vec{i} - \vec{j} - 2\vec{k}$. [5]

OR

If \vec{a} is a constant vector and \vec{r} be the position vector, then, prove that $\nabla \times (\vec{a} \times \vec{r}) = 2\vec{a}$. [5]

15. Determine whether the series is convergent or divergent $\sum_{n=1}^{\infty} (\sqrt[3]{n^3+1} - n)$ [5]

16. Find the interval and radius of convergence of the power series: $\sum_{n=1}^{\infty} \frac{2^n \cdot (x-3)^n}{n+3}$. [5]

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1. If $u = \log \frac{x^2 + y^2}{x + y}$, show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 1$.
2. Find the extreme value of $x^2 + y^2 + z^2$ connected by the relation $ax + by + cz = p$.
3. Evaluate $\int_0^a \int_{\sqrt{ax}}^a \frac{y^2 dy dx}{\sqrt{y^4 - a^2 x^2}}$ by changing order of integration.
4. Evaluate $\int_0^{\log 2} \int_0^x \int_0^{x+\log y} e^{x+y+z} dz dy dx$.
5. Find the length of the perpendicular from the point (3, -1, 11) to the line $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$. Also obtain the equation of perpendicular.
6. Find the magnitude and the equation of S.D. between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $2x - 3y + 27 = 0, 2y - z + 20 = 0$.
7. Find the equation of the sphere through the circle $x^2 + y^2 = 4, z = 0$ and is intersected by the plane $x + 2y + 2z = 0$ is a circle of radius 3.

OR

Find the equations of the tangent planes to the sphere $x^2 + y^2 + z^2 + 6x - 2z + 1 = 0$ which passes through the line $x + z - 16 = 0, 2y - 3z + 30 = 0$.

8. Find the equation of the right circular cone whose vertex at origin and axis is the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ with vertical angle 30° .

OR

Find the equation of the right circular cylinder of radius 2 whose axis is the line

$$\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{2}$$

9. Solve the differential equation $y'' - 4xy' + (4x^2 - 2)y = 0$ by power series method.
10. Express $f(x) = x^3 - 5x^2 + x + 2$ in terms of Legendre polynomials.

11. Show that $4J_n^{(1)}(x) = J_{n-2}(x) - 2J_n(x) + J_{n+2}(x)$.

12. Find a set of vectors reciprocal to the following vectors $2\vec{i} + 3\vec{j} - \vec{k}$, $\vec{i} - \vec{j} - 2\vec{k}$,
 $-\vec{i} + 2\vec{j} + 2\vec{k}$.

13. Prove that the necessary and sufficient condition for the vector function of a scalar variable t to have constant magnitude is $\vec{a} \cdot \frac{d\vec{a}}{dt} = 0$.

14. A particle moves along the curve $x = 4 \cos t$, $y = t^2$, $z = 2t$. Find velocity and acceleration at time $t = 0$ and $t = \frac{\pi}{2}$.

15. Test the convergence of the series $1 + \frac{x}{2} + \frac{2!}{3^2}x^2 + \frac{3!}{4^3}x^3 + \dots$

16. Find the radius and interval of convergence of the power series $\sum_{n=1}^{\infty} \frac{(-1)^n (x-3)^n}{n+1}$.

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- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Find $\frac{du}{dt}$ if $u = \sin\left(\frac{x}{y}\right)$, $x = e^t$ & $y = t^2$
2. Find the extreme value of $x^2 + y^2 + z^2$ connected by the relation $x+z = 1$ and $2y+z = 2$
3. Evaluate: $\iint_R xy \, dx \, dy$ where R is the region over the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ in the first quadrant.
4. Evaluate the integral by changing to polar coordinates $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2 \cdot \sqrt{x^2+y^2} \, dy \, dx$

OR

Evaluate: $\iiint x^{l-1} \cdot y^{m-1} \cdot z^{n-1} \cdot dx \, dy \, dz$, where x, y, z are all positive but

$$\left(\frac{x}{a}\right)^p + \left(\frac{y}{b}\right)^q + \left(\frac{z}{c}\right)^r \leq 1$$

5. Find the equation of the plane through the line $2x+3y-5z = 4$ and $3x-4y+5z = 6$ and parallel to the coordinates axes.
6. Show that the lines $\frac{x-5}{4} = \frac{y-7}{4} = \frac{z-3}{-5}$ & $\frac{x-8}{7} = \frac{y-4}{1} = \frac{z-5}{3}$ are coplanar. Find their point of intersection and equation of plane in which they lie.
7. Find the centre and radius of the circles $x^2 + y^2 + z^2 - 8x + 4y + 8z - 45 = 0$, $x-2y+2z-3=0$
8. Find the equation of a right circular cone with vertex (1,1,1) and axis is the line $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-1}{3}$ and semi vertical angle 30° .
9. Solve by power series method the differential equation $y'' + xy' + y = 0$
10. Find the general solution of the Legendre's differential equation.
11. Prove Bessel's Function $\frac{d[x^{-n}J_n(x)]}{dx} = -x^{-n}J_{n+1}$
12. Prove that: $\left[\begin{matrix} \vec{b} \times \vec{c} & \vec{c} \times \vec{a} & \vec{a} \times \vec{b} \end{matrix} \right] = \left[\begin{matrix} \vec{a} & \vec{b} & \vec{c} \end{matrix} \right]^2$

10/2

13. Find n so that $r^n \vec{r}$ is solenoidal.

14. Prove that the necessary and sufficient condition for a function \vec{a} of scalar variable to

have a constant direction is $\vec{a} \times \frac{d\vec{a}}{dt} = 0$

15. Test the series for convergence or divergence

$$x + \frac{3}{5}x^2 + \frac{8}{10}x^3 + \frac{15}{17}x^4 + \dots + \frac{n^2 - 1}{n^2 + 1}x^n + \dots (x > 0)$$

16. Find the radius of convergence and interval of convergence of the power series

$$\sum_{n=1}^{\infty} \frac{(-1)^n x^n}{n \cdot 2^n}$$

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1. If $\sin u = \frac{\sqrt{x} - \sqrt{y}}{\sqrt{x} + \sqrt{y}}$, show that $x \frac{\delta u}{\delta x} + y \frac{\delta u}{\delta y} = 0$.
2. Obtain the maximum value of xyz such that $x + y + z = 24$.
3. Evaluate: $\iint xy(x+y) dx dy$ over the area between $y = x^2$ and $y = x$.
4. Evaluate $\iiint x^2 dx dy dz$ over the region V bounded by the planes $x = 0, y = 0, z = 0$ and $x + y + z = a$.
5. Find the image of the point $(2, -1, 3)$ in the plane $3x - 2y - z - 9 = 0$.
6. Find the S.D. between the line $\frac{x-6}{3} = \frac{7-y}{1} = \frac{z-4}{1}$ and $\frac{x}{-3} = \frac{y+9}{2} = \frac{2-z}{-4}$. Find also equation of S.D.
7. Obtain the equation of the sphere through the circle $x^2 + y^2 + z^2 = 9, x - 2y + 2z = 5$ as a great circle.
8. Find the equation of cone with vertex $(3, 1, 2)$ and base $2x^2 + 3y^2 = 1, z = 1$.

OR

Find the equation of right circular cylinder whose axis is the line $\frac{x-\alpha}{\ell} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$ and whose radius 'r'

9. Solve the initial value problem $y'' + 2y' + 5y = 0$, given $y(0) = 1, y'(0) = 5$.
10. Define power series. Solve by power series method of differential equation, $y' + 2xy = 0$.
11. Prove the Bessel's function $\frac{d}{dx} [x^n J_n(x)] = x^n J_{n-1}(x)$.
12. Prove if $\vec{\ell}, \vec{m}, \vec{n}$ be three non-coplanar vectors then

$$\begin{bmatrix} \vec{\ell} & \vec{m} & \vec{n} \end{bmatrix} \begin{pmatrix} \vec{a} & \vec{b} \end{pmatrix} = \begin{vmatrix} \vec{\ell} \cdot \vec{a} & \vec{\ell} \cdot \vec{b} & \vec{\ell} \\ \vec{m} \cdot \vec{a} & \vec{m} \cdot \vec{b} & \vec{m} \\ \vec{n} \cdot \vec{a} & \vec{n} \cdot \vec{b} & \vec{n} \end{vmatrix}$$

13. Prove that the necessary and sufficient condition for the vector function of a scalar variable t have a constant magnitude is $\vec{a} \cdot \frac{d\vec{a}}{dt} = 0$.

14. Find the angle between the normal to the surfaces $x \log z = y^2 - 1$ and $x^2 y + z = 2$ at the point $(1, 1, 1)$.

15. Test the convergence of the series $\frac{x}{1.2} + \frac{x^2}{2.3} + \frac{x^3}{3.4} + \dots$

16. Find the interval of cgt, radius of cgt and centre of cgt of power series $\sum \frac{2^n x^n}{n!}$

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1. State Euler's theorem on homogeneous functions of two independent variables. And if

$$\sin u = \frac{\sqrt{x} - \sqrt{y}}{\sqrt{x} + \sqrt{y}} \text{ then prove } x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$$

2. Find the minimum value of the function $F(x, y, z) = x^2 + y^2 + z^2$ when $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$
3. Evaluate: $\iint r^3 dr d\theta$ over the area included between the circles $r = 2 \sin\theta$ and $r = 4 \sin\theta$
4. Evaluate $\int_1^e \int_1^{\log y} \int_1^{e^x} \log z dz dx dy$

OR

Find the volume of sphere $x^2 + y^2 + z^2 = a^2$ using Dirichlet's integral.

5. Prove that the lines

$$\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1} \text{ and } x = \frac{y-7}{-3} = \frac{z+7}{2} \text{ are coplanar and find the equation of plane in which they lie.}$$

6. Show that the shortest distance between two skew lines

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \text{ and } \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5} \text{ is } 1/\sqrt{6}$$

7. A variable plane is parallel to the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ and meets the axes in A, B, C.

$$\text{Prove that the circle ABC lies on the cone } \left(\frac{b}{c} + \frac{c}{b}\right)yz + \left(\frac{c}{a} + \frac{a}{c}\right)zx + \left(\frac{a}{b} + \frac{b}{a}\right)xy = 0$$

8. Find the equation of the right circular cylinder of radius 4 and axis the line $x = 2, y = -z$.

9. Show that the solutions of $x^2 y''' - 3xy'' + 3y' = 0, (x > 0)$ are linearly independent.

OR

Solve the equation $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (x^2 - 4)y = 0$ in series form.

10. Prove that $4J_n'(x) = J_{n-2}(x) - 2J_n(x) + J_{n+2}(x)$ where the symbols have their usual meanings.

11. Apply the power series method to the following differential equation

$$\frac{d^2 y}{dx^2} + x \frac{dy}{dx} + y = 0$$

OR

Find the general solution of Legendre's differential equation.

12. Show that $(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a}) = \begin{bmatrix} \vec{a} & \vec{b} & \vec{c} \\ a & b & c \end{bmatrix} \vec{c}$ and deduce $\begin{bmatrix} \vec{b} \times \vec{c} & \vec{c} \times \vec{a} & \vec{a} \times \vec{b} \\ b \times c & c \times a & a \times b \end{bmatrix} = \begin{bmatrix} \vec{a} & \vec{b} & \vec{c} \\ a & b & c \end{bmatrix}^2$

13. Prove that the necessary and sufficient condition for the function \vec{a} of scalar variable

to have a constant direction is $\vec{a} \times \frac{d\vec{a}}{dt} = 0$

14. Find the angle between the surface $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$

15. Test the convergence of the series $\sum \frac{(n+1)^n x^n}{n^{n+1}}$

16. Find the radius of convergence and the interval of convergence of the power series

$$\sum_{n=1}^{\infty} \frac{(-1)^n (x-1)^2}{\sqrt{n}}$$

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1. State Euler's theorem on homogeneous functions of two independent variables. And if

$$\sin u = \frac{\sqrt{x} - \sqrt{y}}{\sqrt{x} + \sqrt{y}} \text{ then prove } x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$$

2. Find the minimum value of the function $F(x, y, z) = x^2 + y^2 + z^2$ when $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$

3. Evaluate: $\iint r^3 dr d\theta$ over the area included between the circles $r = 2 \sin\theta$ and $r = 4 \sin\theta$

4. Evaluate $\int_1^e \int_1^{\log y} \int_1^{e^x} \log z dz dx dy$

OR

Find the volume of sphere $x^2 + y^2 + z^2 = a^2$ using Dirichlet's integral.

5. Prove that the lines

$$\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1} \text{ and } x = \frac{y-7}{-3} = \frac{z+7}{2} \text{ are coplanar and find the equation of plane in which they lie.}$$

6. Show that the shortest distance between two skew lines

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \text{ and } \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5} \text{ is } 1/\sqrt{6}$$

7. A variable plane is parallel to the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ and meets the axes in A, B, C.

$$\text{Prove that the circle ABC lies on the cone } \left(\frac{b}{c} + \frac{c}{b}\right)yz + \left(\frac{c}{a} + \frac{a}{c}\right)zx + \left(\frac{a}{b} + \frac{b}{a}\right)xy = 0$$

8. Find the equation of the right circular cylinder of radius 4 and axis the line $x = 2, y = -z$.

9. Show that the solutions of $x^2 y''' - 3xy'' + 3y' = 0, (x > 0)$ are linearly independent.

OR

Solve the equation $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (x^2 - 4)y = 0$ in series form.

10. Prove that $4J_n(x) = J_{n-2}(x) - 2J_n(x) + J_{n+2}(x)$ where the symbols have their usual meanings.

11. Apply the power series method to the following differential equation

$$\frac{d^2 y}{dx^2} + x \frac{dy}{dx} + y = 0$$

OR

Find the general solution of Legendre's differential equation.

12. Show that $(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a}) = \begin{bmatrix} \vec{a} & \vec{b} & \vec{c} \end{bmatrix} \vec{c}$ and deduce $\begin{bmatrix} \vec{b} \times \vec{c} & \vec{c} \times \vec{a} & \vec{a} \times \vec{b} \end{bmatrix} = \begin{bmatrix} \vec{a} & \vec{b} & \vec{c} \end{bmatrix}^2$

13. Prove that the necessary and sufficient condition for the function \vec{a} of scalar variable

to have a constant direction is $\vec{a} \times \frac{d\vec{a}}{dt} = 0$

14. Find the angle between the surface $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point (2, -1, 2)

15. Test the convergence of the series $\sum \frac{(n+1)^n x^n}{n^{n+1}}$

16. Find the radius of convergence and the interval of convergence of the power series

$$\sum_{n=1}^{\infty} \frac{(-1)^n (x-1)^2}{\sqrt{n}}$$

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1. State Euler's theorem for homogeneous function of two variables. If $u = \cos^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$,

then prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = -\frac{1}{2} \cot u$. [1+4]

2. Find the minimum value of $x^2 + xy + y^2 + 3z^2$ under the condition $x + 2y + 4z = 60$. [5]
3. Change the order of integration and hence evaluate the same.

$$\int_0^a \int_0^x \frac{\cos y \, dy \, dx}{\sqrt{(a-x)(a-y)}} \quad [5]$$

4. Find by double integration, the volume bounded by the plane $z = 0$, surface $z = x^2 + y^2 + 2$ and the cylinder $x^2 + y^2 = 4$. [5]

5. Prove that the plane through the point (α, β, γ) and the line $x = py + q = rz + s$ is given by:

$$\begin{vmatrix} x & py+q & rz+s \\ \alpha & p\beta+q & r\gamma+s \\ 1 & 1 & 1 \end{vmatrix} = 0. \quad [5]$$

6. Find the magnitude and equation of the shortest distance between the lines: [5]

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \quad \text{and} \quad \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$$

7. Find the equation of the sphere through the circle $x^2 + y^2 + z^2 - 3x + 4y - 2z - 5 = 0$, $5x - 2y + 4z + 7 = 0$ as a great circle. [5]

OR

Find the equation which touches the sphere $x^2 + y^2 + z^2 + 2x - 6y + 1 = 0$ at $(1, 2, -2)$ and passes through the point $(1, -1, 0)$. [5]

8. Find the equation of the cone with vertex (α, β, γ) and base $y^2 = 4ax, z = 0$ [5]

9. Solve the initial value problem

$$y'' - 4y' + 3y = 10e^{-2x}, \quad y(0) = 1, \quad y'(0) = 3. \quad [5]$$

10. Solve by power series method the differential equation $y'' - 4xy' + (4x^2 - 2)y = 0$. [5]

11. Express $f(x) = x^3 - 5x^2 + 6x + 1$ in terms of Legendre's polynomials.

[5]

OR

Prove that $\frac{d}{dx} [x^{-n} J_n(x)] = -x^{-n} J_{n+1}(x)$.

[5]

12. Find a set of vectors reciprocal to the following vectors:

[5]

$$-\vec{i} + \vec{j} + \vec{k}, \quad \vec{i} - \vec{j} + \vec{k}, \quad \vec{i} + \vec{j} - \vec{k}$$

13. Prove that $\vec{b} \times \vec{c}$, $\vec{c} \times \vec{a}$ and $\vec{a} \times \vec{b}$ are coplanar or non-coplanar according as \vec{a} , \vec{b} , \vec{c} are coplanar or non-coplanar.

14. Prove that $\text{curl} (\vec{a} \times \vec{b}) = \vec{a} \text{ div } \vec{b} - (\vec{a} \cdot \nabla) \vec{b}$

[5]

OR

If $\vec{u} = x + y + z$, $\vec{v} = x^2 + y^2 + z^2$ and $w = xy + yz + zx$, show that $[\text{grad } u \text{ grad } v \text{ grad } w] = 0$

15. Test the convergence of the series:

[5]

$$2x + \frac{3x^2}{8} + \frac{4x^3}{27} + \dots + \frac{(n+1)}{n^3} x^n + \dots$$

16. Find the radius of convergence and the interval of convergence of the power series:

[5]

$$\sum_{n=0}^{\infty} \frac{(-1)^n (x-3)^n}{n+1}$$

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1. ✓ State Euler's Theorem for a homogeneous function of two independent variables and verify it for the function: [1+4]

$$u = \frac{x^{1/4} + y^{1/4}}{x^{1/5} + y^{1/5}}$$

2. Find the extreme value of $\phi = x^2 + y^2 + z^2$ connected by the relation $ax + by + cz = p$ [5]

3. ✓ Evaluate: $\iint_R xy dx dy$ where R is the region over the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ in the first quadrant. [5]

4. ✓ Transform to polar coordinates and complete the integral $\int_0^{2a} \int_0^{\sqrt{2ax-x^2}} (x^2 + y^2) dy dx$. [5]

OR

Evaluate: $\iiint x^{l-1} \cdot y^{m-1} \cdot z^{n-1} dx dy dz$

where x, y, z are all positive but $\left(\frac{x}{a}\right)^p + \left(\frac{y}{b}\right)^q + \left(\frac{z}{c}\right)^r \leq 1$.

5. ✓ Find the length of perpendicular from the point $(3, -1, 11)$ to the line $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$. [5]
Also obtain the equation of the perpendicular.

6. ✓ Find the length and equation of the shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$; $2x - 3y + 27 = 0 = 2y - z + 20$. [5]

7. ✓ Find the centre and radius of the circle in which the sphere $x^2 + y^2 + z^2 - 8x + 4y + 8z - 45 = 0$ is cut by the plane $x - 2y + 2z = 3$. [5]

8. Plane through OX and OY include an angle α . Show that their line of intersection lies on the cone $z^2(x^2 + y^2 + z^2) = x^2 y^2 \tan^2 \alpha$. [5]

OR

Find the equation of the right circular cylinder whose guiding curve is the circle $x^2 + y^2 + z^2 - x - y - z = 0, x + y + z = 1$.

9. Solve in series:

[5]

$$(1+x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = 0.$$

10. Show that:

[5]

$$J_{\frac{5}{2}}(x) = \sqrt{\frac{2}{\pi x}} \left(\frac{3-x^2}{x^2} \sin x - \frac{3}{x} \cos x \right)$$

11. Show that:

[5]

$$P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n} (x^2 - 1)^n$$

12. Prove that $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) + (\vec{a} \times \vec{c}) \times (\vec{d} \times \vec{b}) + (\vec{a} \times \vec{d}) \times (\vec{b} \times \vec{c}) = -2 \times [\vec{b} \ \vec{c} \ \vec{d}] \vec{a}$

[5]

13. Prove that the necessary and sufficient condition for the vector function \vec{a} of scalar variable λ to have a constant magnitude is $\left(\vec{a} \frac{d\vec{a}}{dt} \right) = 0$.

[5]

14. Apply the power series method to solve following differential equation

[5]

$$(1-x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$$

15. Test the convergence of the series $\frac{1}{2} + \frac{2}{3}x + \left(\frac{3}{4}\right)^2 x^2 + \left(\frac{4}{5}\right)^3 x^3 + \dots$

[5]

16. Show that $J_4(x) = \left(\frac{48}{x^3} - \frac{3}{x}\right)J_1(x) + \left(1 - \frac{24}{x^2}\right)J_0(x)$.

[5]

Exam.	New Back (2066 Batch Only)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Mathematics II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. State Euler's theorem of homogeneous equation of two variables. If $u = \sin^{-1} \frac{\sqrt{x} - \sqrt{y}}{\sqrt{x} + \sqrt{y}}$.

Show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$.

[1+4]

2. Find the extreme value of $x^2 + y^2 + z^2$ subject to the condition $x + y + z = 1$.

[5]

3. Evaluate $\iint_R xy dx dy$ where R is the region over the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ in the first quadrant.

[5]

4. Evaluate the integral by changing to polar co-ordinates. $\int_0^1 \int_x^{\sqrt{2x-x^2}} (x^2 + y^2) dy dx$.

OR

Find by triple integral, the volume common to the cylinders $x^2 + y^2 = a^2$ and $x^2 + z^2 = a^2$.

[5]

5. Prove that $(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a}) = [\vec{a} \ \vec{b} \ \vec{c}] \vec{c}$ and deduce that $[\vec{b} \times \vec{c}, \vec{c} \times \vec{a}, \vec{a} \times \vec{b}] = [\vec{a} \ \vec{b} \ \vec{c}]^2$.

[5]

6. Prove that the necessary and sufficient condition for the vector function of a scalar variable t have constant magnitude is $\vec{a} \frac{d\vec{a}}{dt} = 0$.

[5]

7. The position vector of a moving particle at any point is given by $\vec{r} = (t^2 + 1)\vec{i} + (4t - 3)\vec{j} + (2t^2 - 6)\vec{k}$. Find the velocity and acceleration at $t = 1$. Also obtain the magnitudes.

[5]

8. Prove that the lines $x = ay + b, z = cy + d$ and $x = a'y + b', z = c'y + d'$ are perpendicular if $aa' + cc' + 1 = 0$.

[5]

9. Prove that the lines $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$ and $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$ intersect. Find also their point of intersection and plane through them.

[5]

10. Find the centre and radius of the circle $x^2 + y^2 + z^2 + x + y + z = 4, x + y + z = 0$.

[5]

11. Show that the equation of a cone whose vertex is (α, β, γ) and base the parabola $z^2 = 4ax, y = 0$ is $(\beta z - \gamma y)^2 = 4a(\beta - y)(\beta x - \alpha y)$. [5]

OR

Find the equation of the right circular cylinder of radius 4 and axes of the line $x = 2y = -z$.

12. Test the convergence of the series $\frac{2}{1^p} + \frac{3}{2^p} + \frac{4}{3^p} + \frac{5}{4^p} + \frac{6}{5^p} + \dots$ [5]

13. Find the radius of convergence and interval of convergence of the series

$$\sum_{n=0}^{\infty} \frac{(-1)^n (x-3)^n}{(n+1)} \quad [5]$$

14. Solve $(x+a)^2 \frac{d^2y}{dx^2} - 4(x+a) \frac{dy}{dx} + 6y = x$. [5]

15. Solve the initial value problem $y'' + y' - 2y = -6 \sin 2x - 18 \cos 2x = 0, y(0) = 0, y'(0) = 0$. [5]

16. Show that $J_{-n}(x) = (-1)^n J_n(x)$.

OR

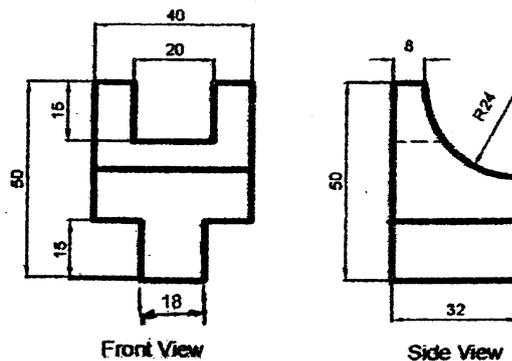
Find the general solution of Legendre's differential equation. [5]

Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

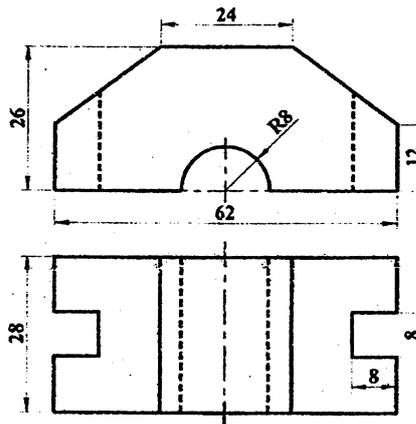
Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. From the given front and side view of a solid draw the isometric view. [10]



2. Draw oblique drawing from the given orthographic views as shown in figure below. [5]

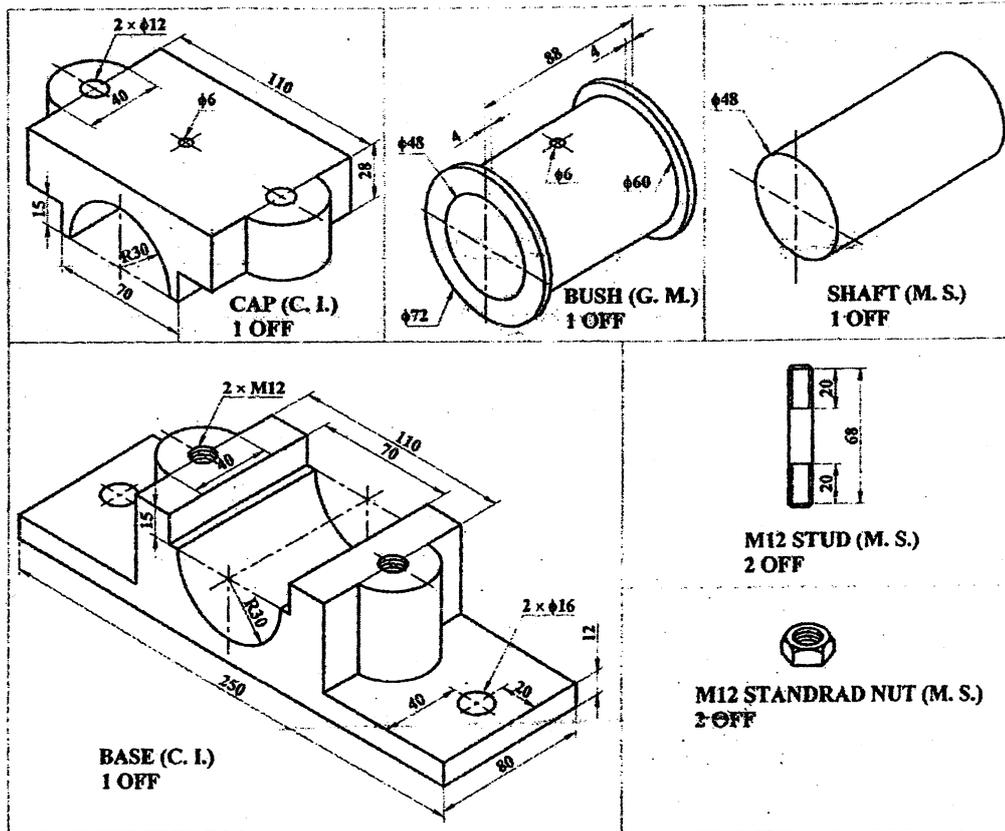


3. Determine the limit, tolerance, allowances and type of fit for 50 H7/p6. The value of fundamental deviation given by H is zero and p is above the basic line and value is 0.032 mm, and international tolerance given by 7 is 0.025 and 6 is 0.016 mm respectively. [4]

OR

Draw the top view and sectional front view of double row zig zag type riveted single strap butt joint for 8 mm thick plate.

4. Figure below shows the details of a split bearing. Draw the assembled front view with section. Take any length for the shaft. [16]

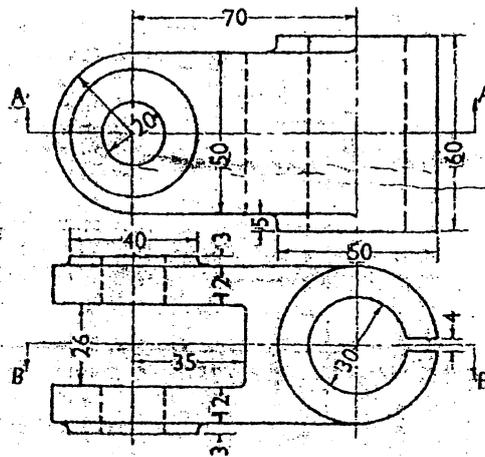


5. Draw the standard symbols for the following: [5]

- | | | |
|---|-------------|----------------|
| a) Surface to be obtained by fine turning | c) Tee | d) Reducer |
| b) Gate valve | f) DC Motor | g) Transformer |
| e) Thermocouple | i) Fuse | j) Speaker |

OR

Orthographic views of a forked end of a machine part are shown in figure below. Draw its sectional front view (Section B-B).



Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Orthographic views of an object are shown in Figure P.1. Draw its isometric view. [9]
2. A cylinder having 70 mm diameter and 40 mm height is surmounted by a square pyramid having side 35 mm and height 50 mm. Draw the angular perspective projection when one of the side of pyramid is 30° inclined and its nearest corner is 30 mm behind the projection plane. Take station point 35 mm in front of projection plane, 25 mm left of nearest corner and 110 mm above the ground level. [6]
3. Sketch the top view and sectional front view of double row, single cover zig zag Butt joint. [5]

OR

Sketch the symbols for the following [5]

- | | |
|------------------------|--------------------------------|
| a) Spot weld | f) Hand set |
| b) Internal thread | g) Temple |
| c) Fan regulator | h) Material removed by turning |
| d) 3-phase transformer | i) Rapids |
| e) Circuit breaker | j) Perpendicular lay |
4. The assembly drawing of Hand Vice is shown in Figure P.4. Draw detail drawing of each component. Assume suitable thickness if necessary. Part list is given below. [15]

Part List

SN	Part Name	Part No.	Quantity
1	Body	1	1
2	Screw	2	1
3	Screw Base	3	1
4	Handle	4	1
5	Handle end	5	2
6	Pin		2

5. Determine limits, tolerance, allowance and types of fit designated by 80 D9/h8. The fundamental deviation of hole is 0.032 mm more than fundamental deviation of shaft. International tolerance grades for 8 and 9 are 0.034 mm and 0.042 mm respectively. [5]

10/07

Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II (EG481ME)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw isometric drawing from the given orthographic views as shown in **Figure P.1**. [10]
2. Draw oblique drawing from the given orthographic views as shown in **Figure P.2**. [6]

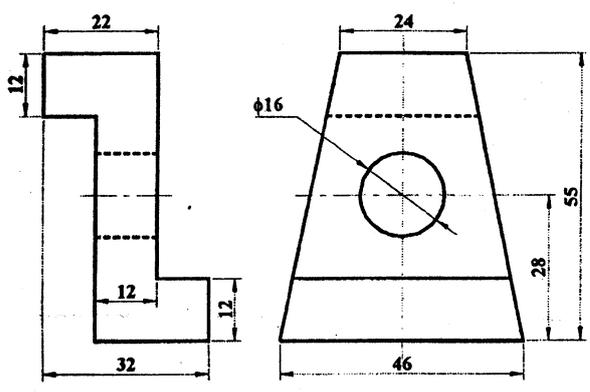


Figure P.1

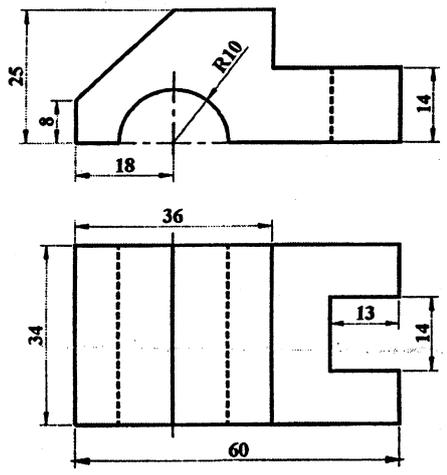


Figure P.2

3. Sketch the top view and sectional front view of single riveted, double strap butt joint. [5]

OR

Determine the limits of dimensions and type for fit designated by H8/c11 for the basic size of 50 mm, assuming fundamental deviation for H and c respectively as 0 μm above the basic size line and 125 μm below the basic size line and international tolerance grades for 8 and 11 as 39 μm and 110 μm.

4. Draw the standard symbols for the following: [5]
 - (a) Union
 - (b) Transformer
 - (c) Circular tube
 - (d) Fuse
 - (e) Elbow
 - (f) Hill Contours
 - (g) Butt weld
 - (h) Coated surface
 - (i) Speaker
 - (j) Internal thread (any view)

5. Draw the assembled front view with section from the following detail drawings shown in Figure P.5. [14]

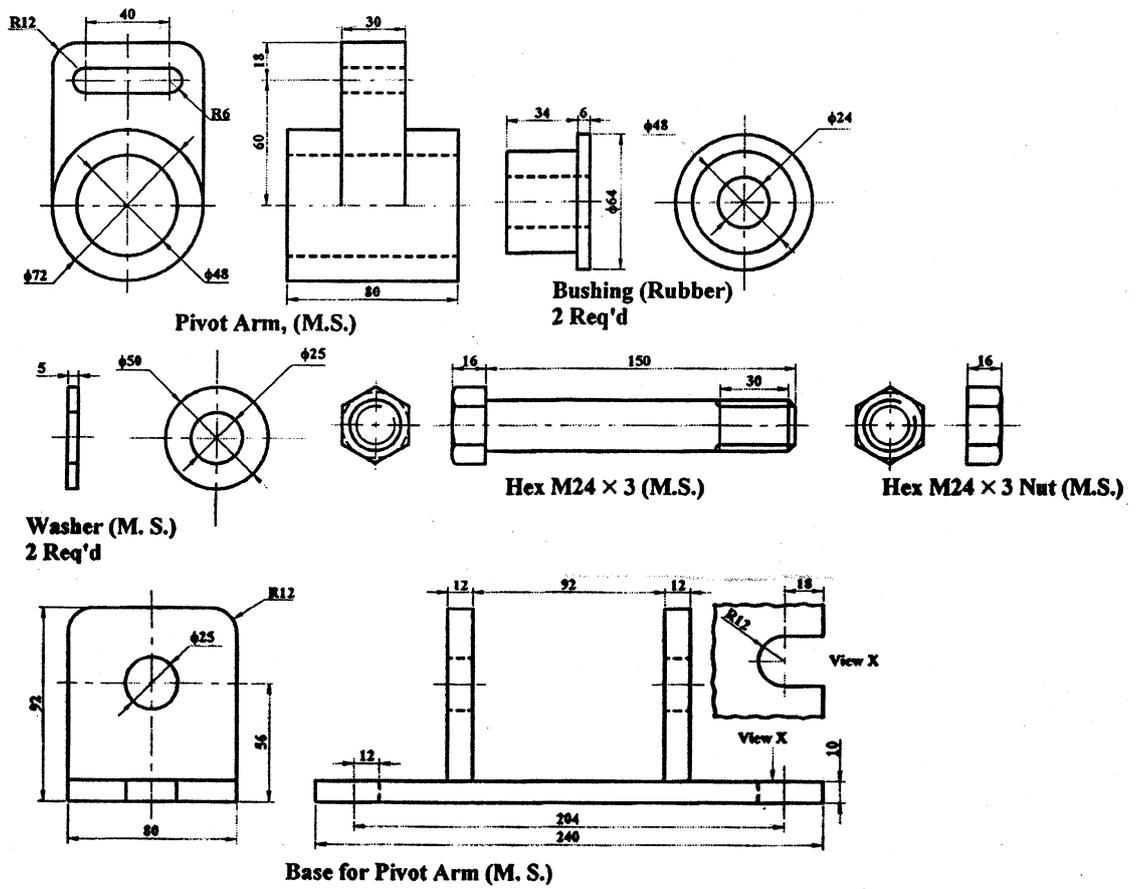


Figure P.5

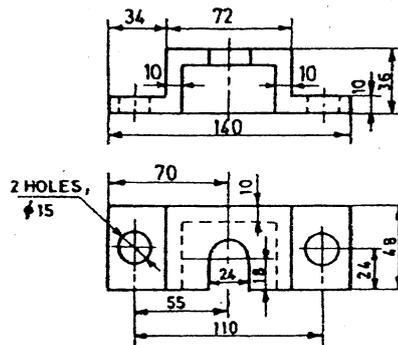
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	All (Except B.Arch)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Draw Isometric drawing of the object shown by figure below.

[10]



2. A square prism of base 30 mm×30 mm base and height 50 mm is lying in the ground. One of its sides of the base makes angle 30° with the PP and nearest corner is 10 mm behind the PP. The station point is 40 mm in front of PP and 70 mm above from GP and containing by central plane. Draw the perspective view.
3. Sketch top view and sectional front view for a double riveted, double strap zig-zag butt joint, where $d=12$ mm.

[6]

[5]

OR

In the free hand sketch make complete fit analysis of the following symbols. 60S6/h12 given: F.D. for 'h' and 'S' are 0.00 and -0/42 respectively; ITG for 6 and 12 are 0.019 and 0.30 respectively. [Indicate type of fit, allowance, upper and lower deviation and shaft basis or hole basis system]

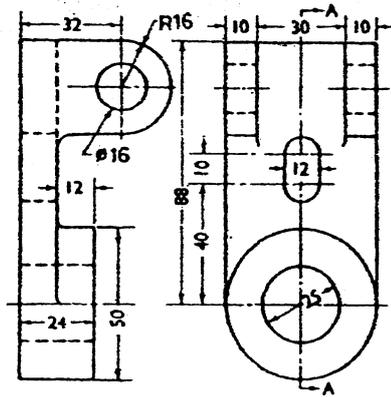
4. Sketch symbols of followings:

- | | |
|----------------|--|
| i) Pond | vi) Surface to be obtained without removal of material |
| ii) School | vii) Surface to be coated |
| iii) Amplifier | viii) Fluorescent bulb |
| iv) Nipple | ix) Fillet weld |
| v) 90° elbow | x) Cross |

OR

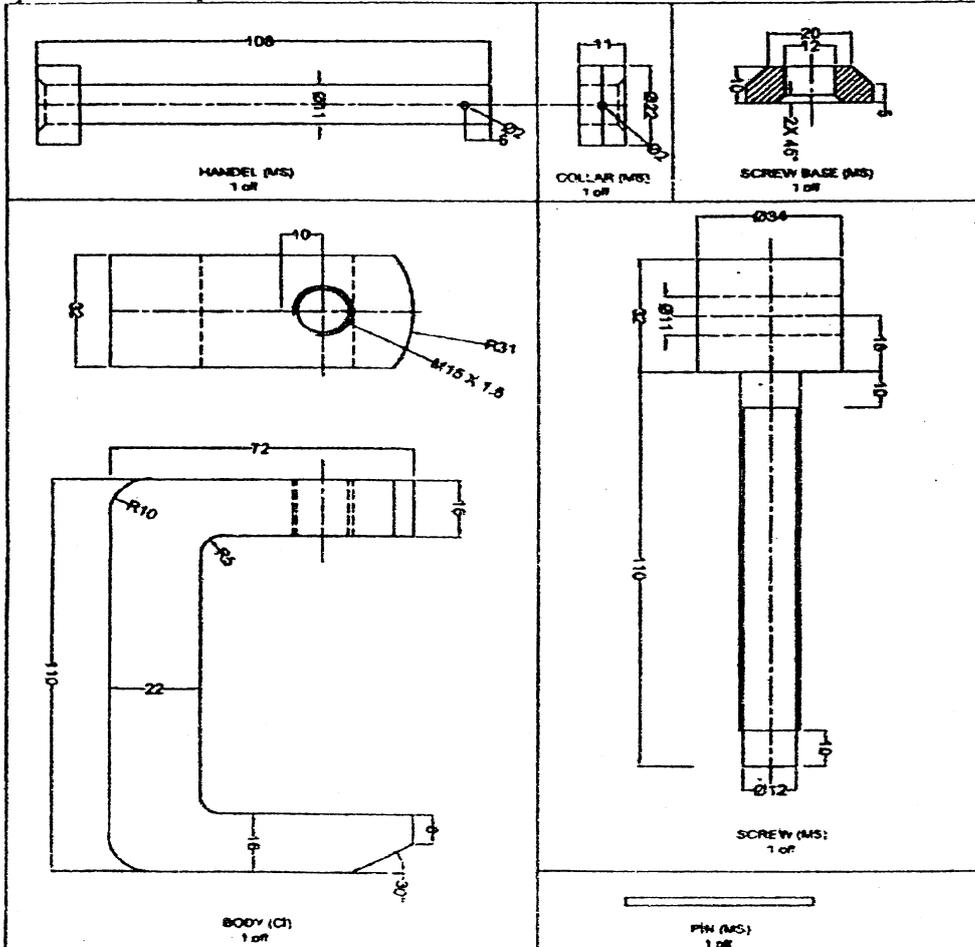
Orthographic projection of an object in third angle projection is shown in figure below. Draw its sectional side view, section A-A.

[5]



5. Assemble the following detail drawing shown in figure below and draw front view and top view of C-Clamp.

[14]

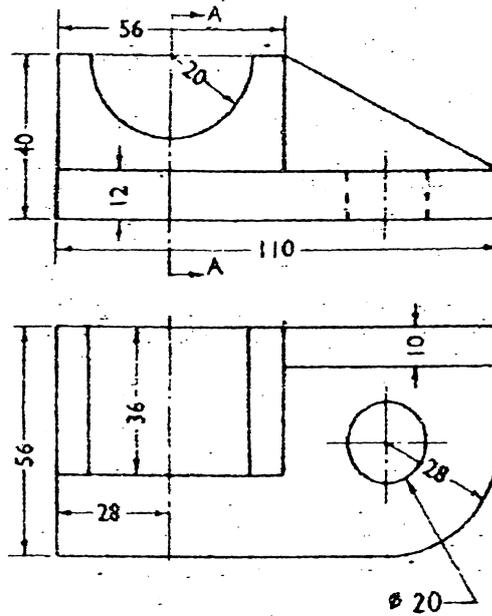


Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

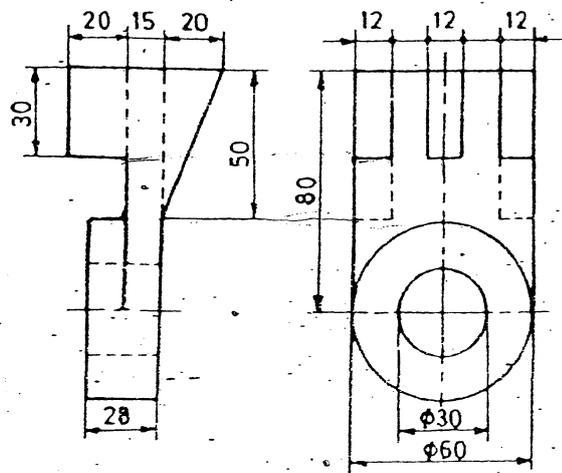
Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Orthographic views of an object are shown in figure. Draw its isometric view. [10]



2. Draw oblique drawing of the object shown in figure. [6]



3. Sketch the top view and sectional front view of double row, zig-zag type lap riveted joint. Take diameter of the rivet as 12 mm. [5]

OR

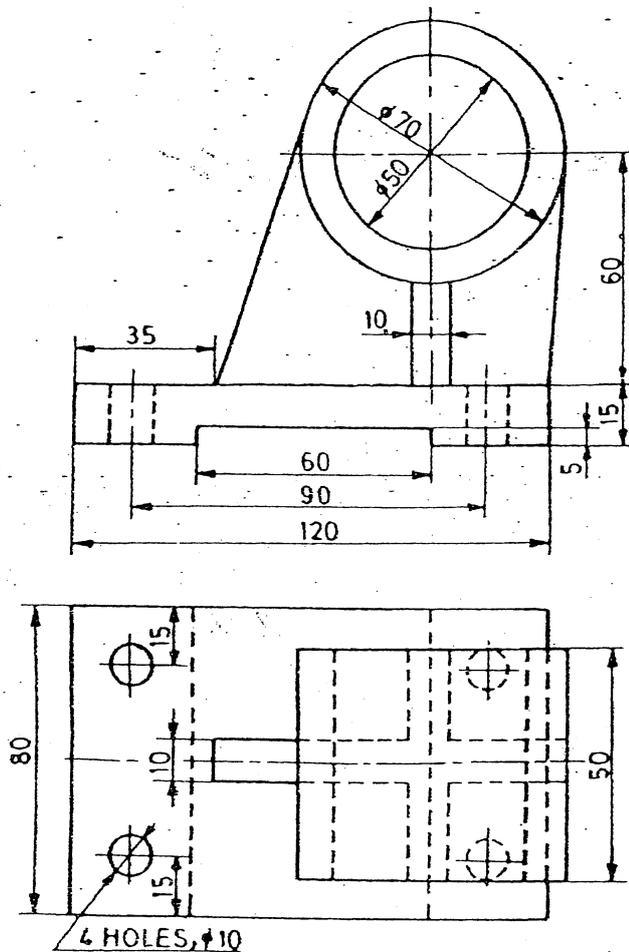
Determine the limits of dimensions and type of fit designated by H7/s6 for the basic size of 100 mm. Take fundamental deviation for H and s respectively as 0.000 and 0.071 mm and international tolerance grades for 7 and 6 as 0.035 and 0.022 mm respectively. [5]

4. Sketch freehand graphical symbol of [5]

- | | | | |
|--------------------|----------------|--------------|-----------------|
| a) Battery | b) Plug | c) Switch | d) DC Generator |
| e) Reducer | f) Bridge | g) Spot Weld | h) Cross |
| i) External Thread | j) Check Valve | | |

OR

Draw full sectional front view of object shown in figure. [5]

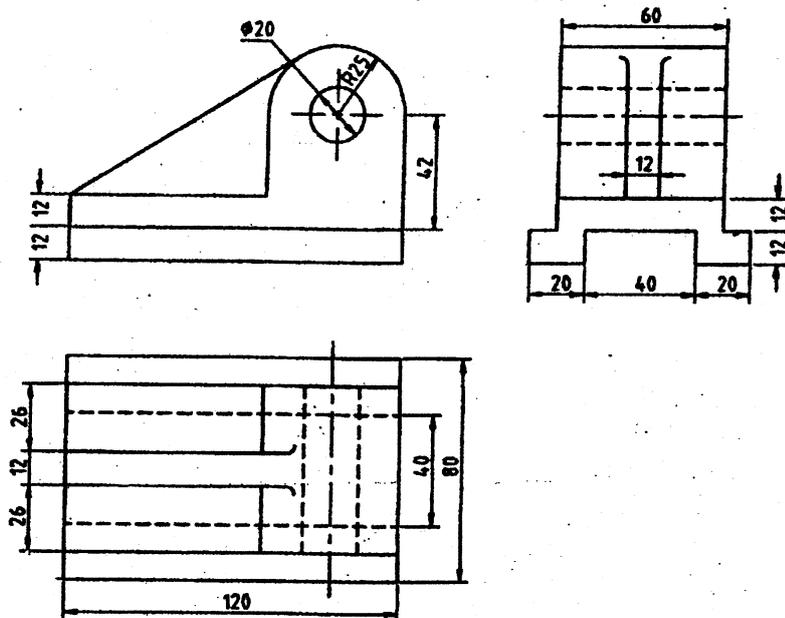


Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	All (except B. Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Figure below shows the orthographic projections of a guide bracket for a horizontal spindle. Draw its isometric view. [10]



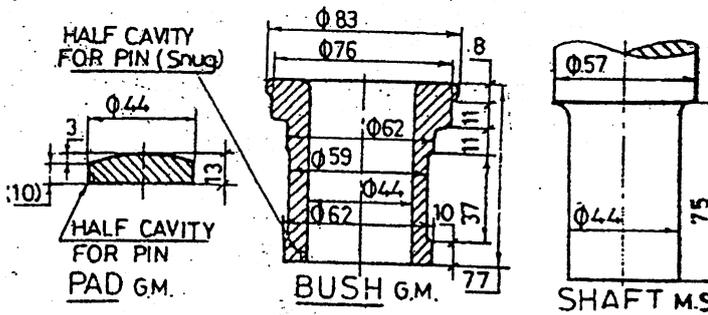
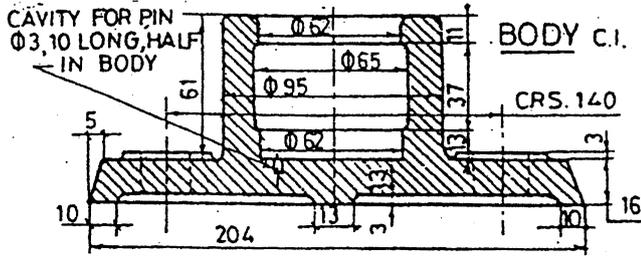
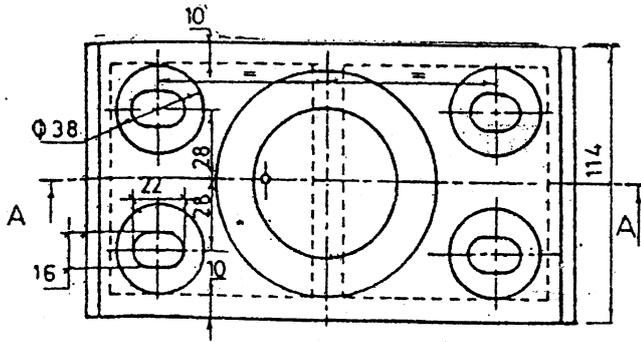
A solid square prism of 30mm side and height 60mm is resting with its base on the ground plane such that its rectangular faces are inclined at 45 degree to the picture plane and the vertical edge nearer to the PP is 15mm behind it. The station point is 60mm in front of PP, 100mm above ground plane and lies in the central plane, which passes from the center of prism. Draw perspective view of the prism. [5]

3. Determine the limits of dimensions for the H6/s7, type of fit and fundamental deviations for the basic size of 50mm, assuming fundamental deviation for "H" and "s" respectively as 0mm above the basic size line and 0.034mm above the basic size line and international tolerance grades for "6" and "7" as 0.016mm and 0.025mm respectively. [5]

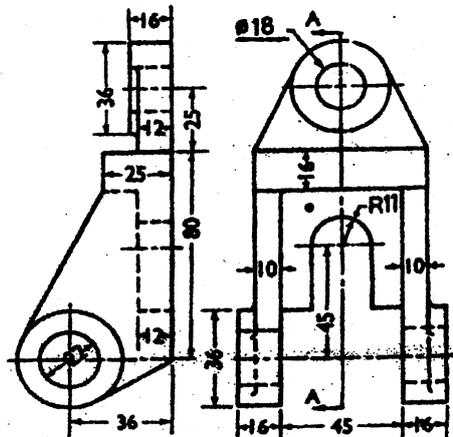
OR

Sketch sectional front view and top view of double row, zig-zag type, double strap butt riveted joint. [5]

4. Draw an assembled sectional front view and top view from the following detail drawings shown in figure below. [15]



5. Orthographic projection of an object in first angle projection is shown in figure below. Draw its sectional front view section A-A. [5]



OR

Sketch the symbols for the following.

- | | |
|-------------------------------------|-----------------------|
| a) NPN type transistor | b) Transformer |
| c) Hill contour | d) Single phase motor |
| e) Siren | f) Internal thread |
| g) Elbow 90° | h) Fillet |
| i) Surface to be obtained by filing | j) Highway bridge |

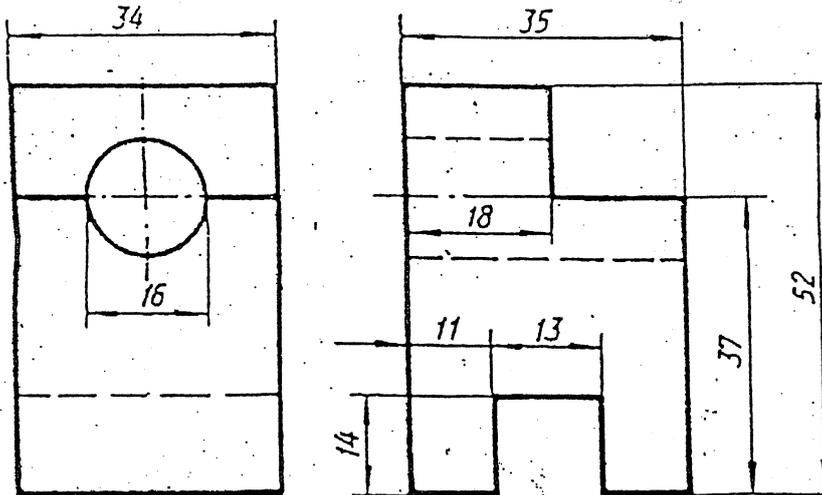
Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

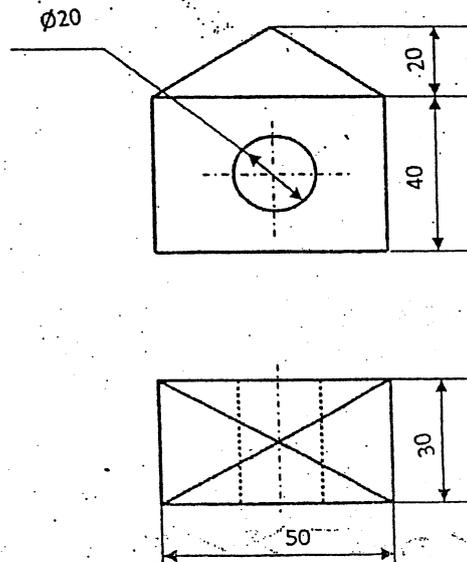
1/ Draw isometric drawing of an object shown in figure below.

[9]



2/ Draw the angular perspective views from given orthographic projections as shown in figure below.

[7]



3/ Draw the standard symbols for the following:

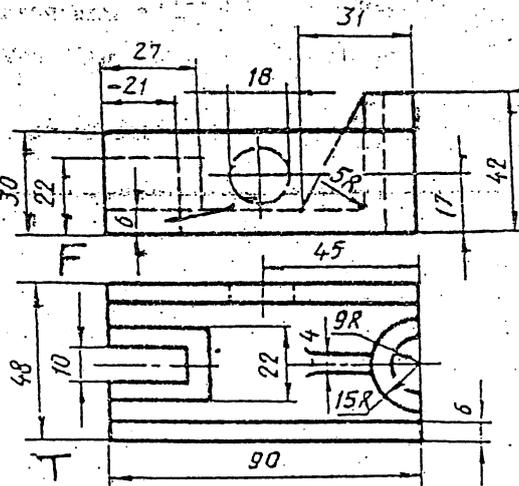
[5]

- | | |
|----------------------------------|--------------------------|
| a) Square butt | b) Cap |
| c) Surface to obtained by filing | d) Amplifier |
| e) PNP-type transistor | f) AC motor single phase |
| g) Angle | h) Antenna |
| i) Lake | j) Hill contours |

OR

Replace front view by sectional view of figure below.

[5]



4. Determine the limits of dimensions and type of fit designated by $60\text{ H}8/f7$, assuming fundamental deviation for H and f respectively as $0\text{ }\mu\text{m}$ above the basic size line and $25\text{ }\mu\text{m}$ below the basic size line and the values of international tolerance grades for 8 and 7 as $39\text{ }\mu\text{m}$ and $25\text{ }\mu\text{m}$.

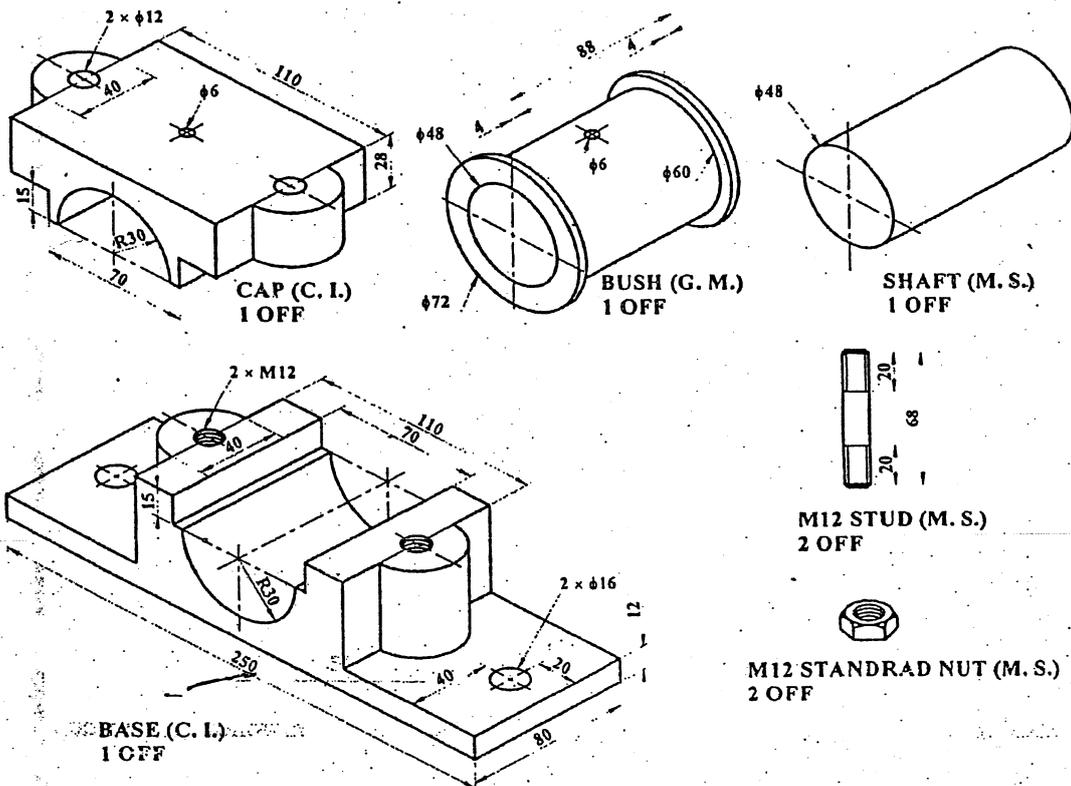
[5]

OR

Draw sectional front view and top view of double row, zig-zag type, single strap butt riveted joint.

5. Draw the assembled front view with section from the following detail drawings shown in figure below.

[14]

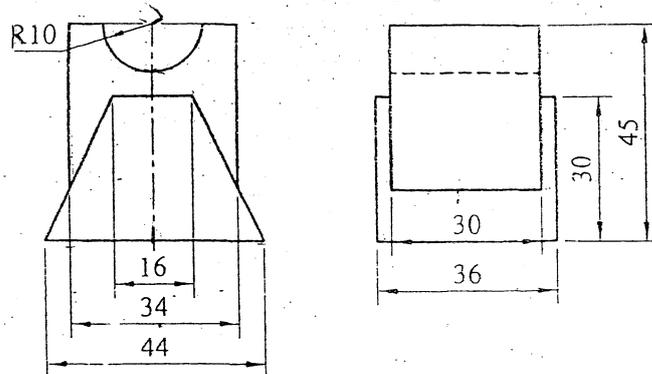


Exam:	Regular / Back		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

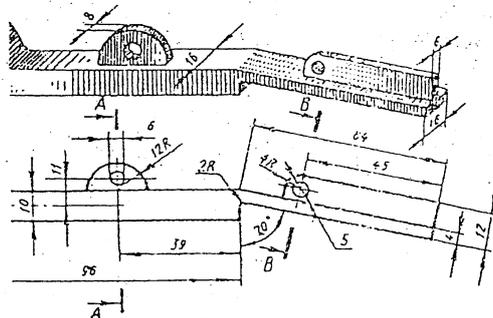
1. Orthographic views of an object are shown in figure below. Draw its isometric view. [10]



2. A solid box of size $60 \times 45 \times 40$ mm is resting with its base (60×45) on the ground plane. Draw its angular perspective view with its vertical faces equally inclined to the picture plane (PP) and the nearest vertical edge is touching the PP. The station point is 80mm above ground level, 40mm away from the PP and the central plane passes from the vertical edge which is touching the PP. [5]

3. The production drawing of coupling is shown in figure 3. Draw its assembled half sectional front view and side view. [15]

4. Sketch revolved section at A-A and removed section at B-B for the link as shown in figure below. [5]



OR

Sketch the graphical symbols for the following. [5]

- | | |
|--------------------------------|--------------------|
| a) End view of external thread | b) Capacitor |
| c) Square section | d) Resistor |
| e) Thermocouple | f) Hill contour |
| g) Delta connection | h) Circuit breaker |
| i) V-weld | j) Church |

5. Determine limits, tolerance, allowance and types of fit designated by 80T8/h5. The value of fundamental deviation given by 'h' is zero and 'T' is -0.024mm . International tolerance grades for 8 and 5 are 0.032mm and 0.014mm respectively. [5]

OR

Sketch the single strap, double row, zig zag butt joint with top view and sectional front view. [5]

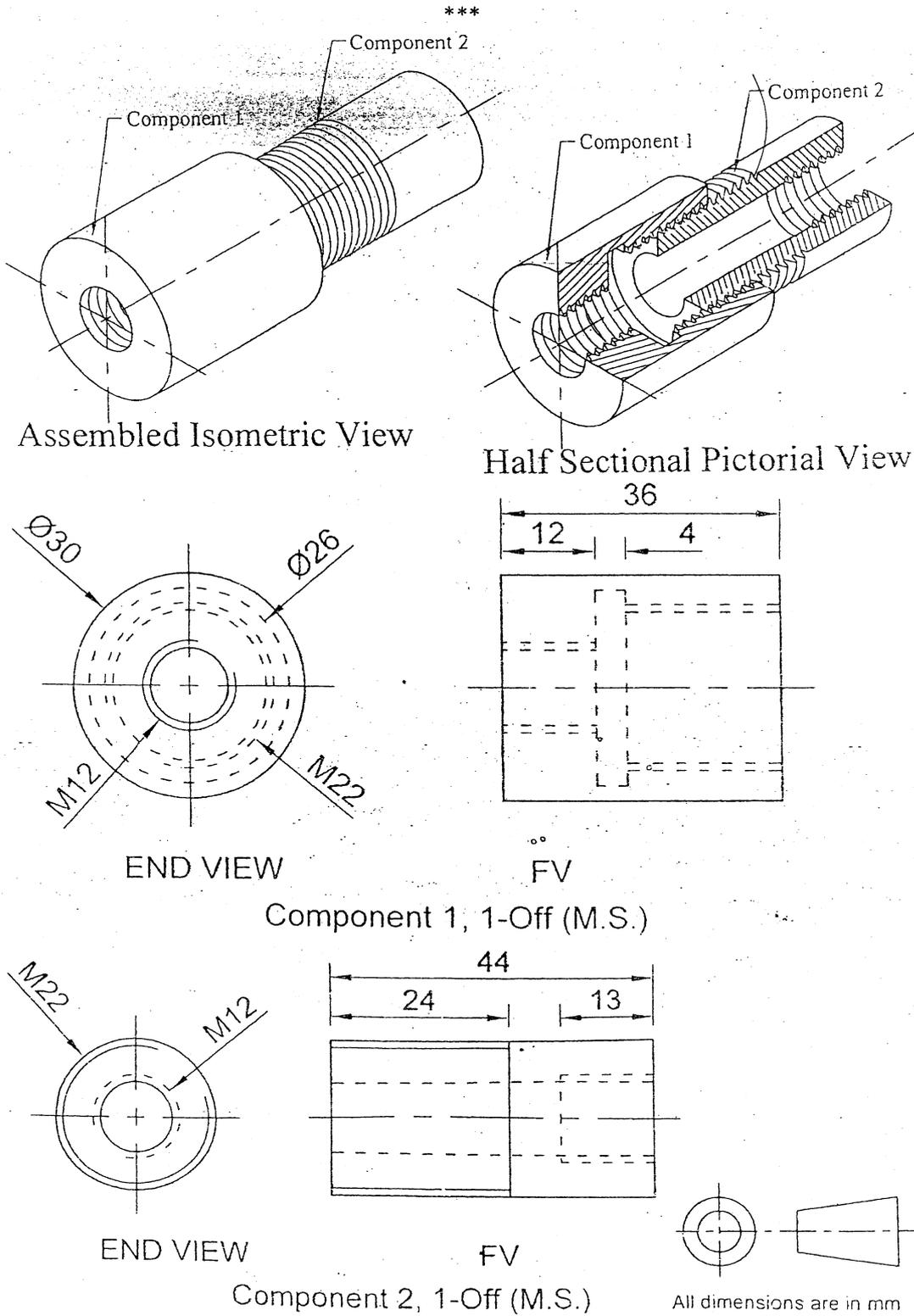


Figure 3

Exam. Level	New Back (2066 Batch Only)		
	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Drawing II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Orthographic views of an object are shown in Figure 1. Draw its isometric view. [10]
2. A solid cube having 50mm sides, is resting with its flat base on the ground plane. Draw its angular perspective view with its vertical faces equally inclined to the picture plane (PP) and the nearest vertical edge is touching the PP. The station point is 80mm above ground level, 40mm away from the PP and the central plane passes from the centre of the solid cube. [5]
3. The production drawing of coupling is shown in figure 3. Draw its assembled half sectional front view and the side (or end) view. [15]

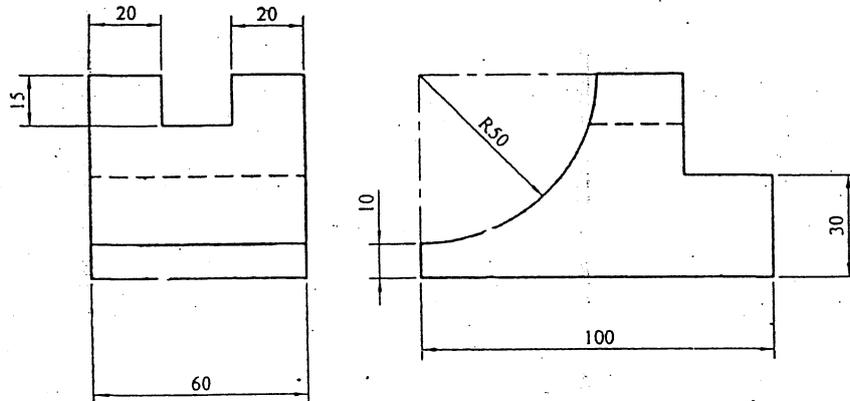


Figure 1

4. Sketch revolved section at A-A and removed section at B-B for the link as shown in figure 4. [5]

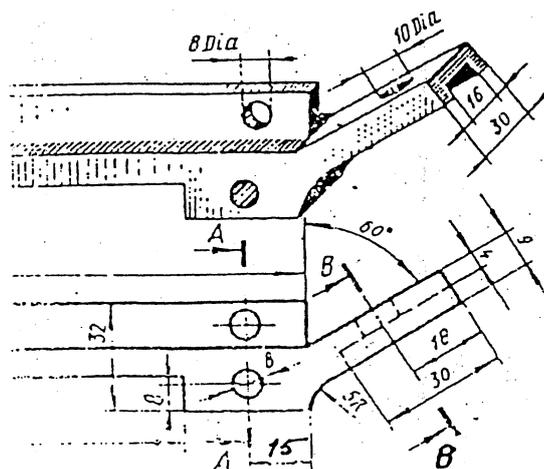


Figure 4

OR

OR

Sketch the symbols for the following:

[5]

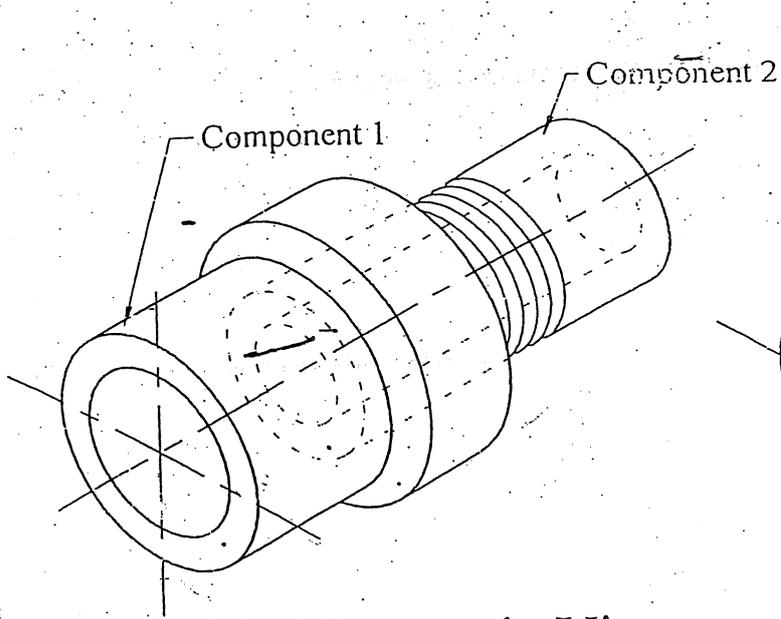
- | | |
|-----------------------|----------------------------|
| a) Single U Butt weld | b) Reducing pressure valve |
| c) Wall mounted fan | d) Siren |
| e) Rectifier | f) Antenna |
| g) Capacitor | h) Multidirectional lay |
| i) Embankment | j) Thermocouple |
5. Determine limits, tolerance, allowance and types of fit designated by 60B7/h8. The fundamental deviation of hole is 0.042 mm more than fundamental deviation of shaft. International tolerance grades for ϕ and δ are 0.024 mm and 0.021 mm respectively. The value of fundamental deviation given by 'h' is zero.

[5]

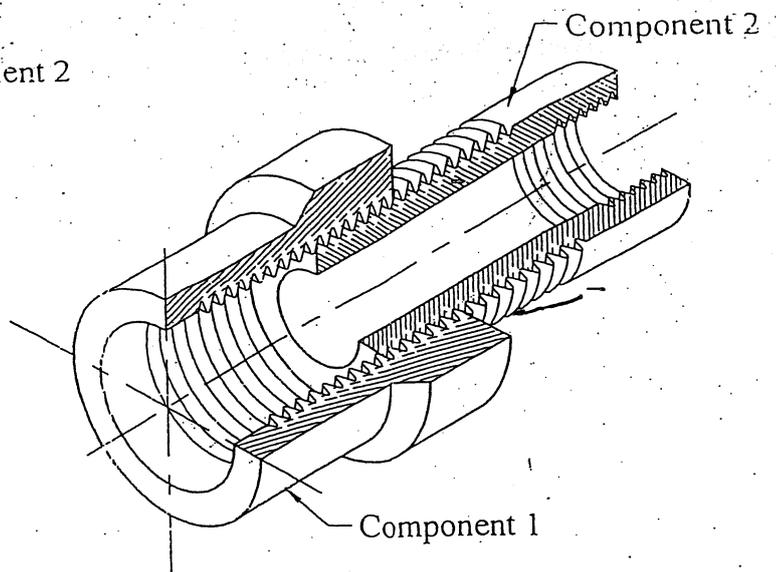
OR

Sketch the triple row, zigzag lap joint with top view and sectional front view.

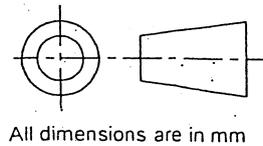
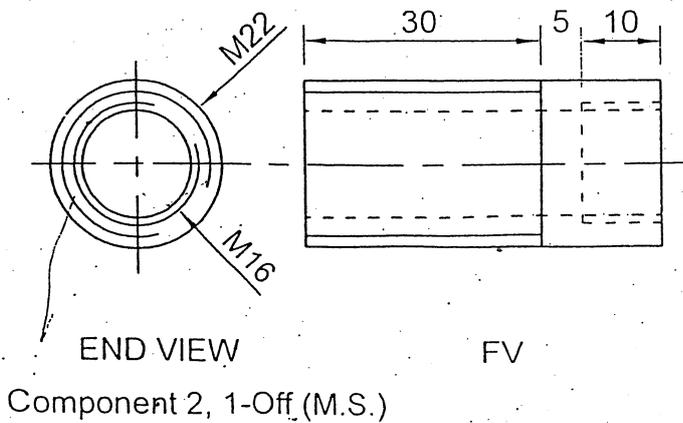
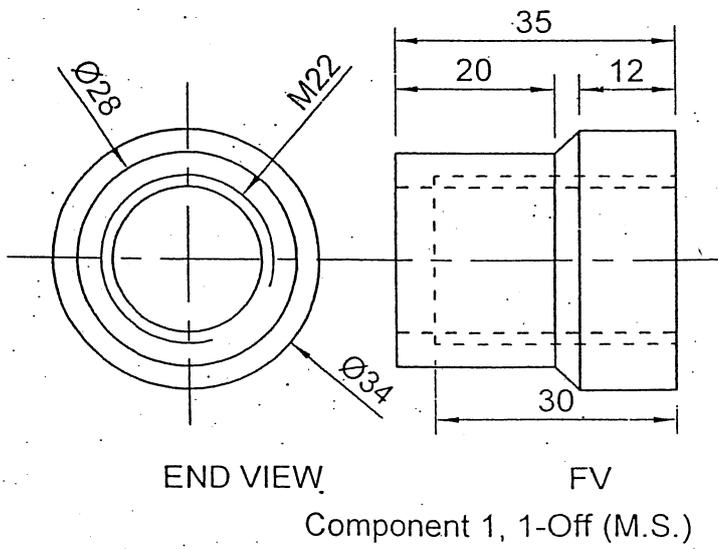
[5]



Assembled Isometric View

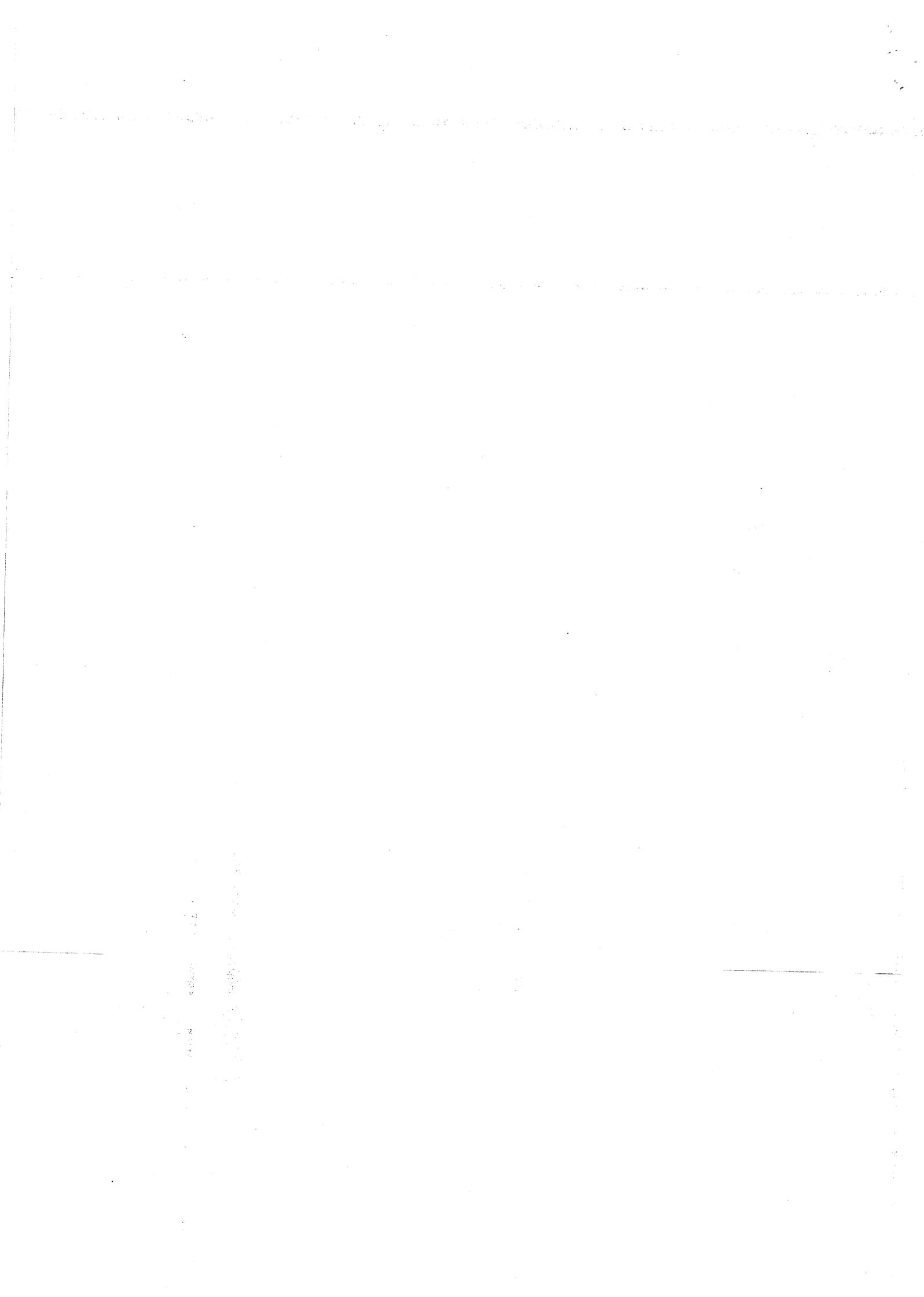


Half Sectional Pictorial View



All dimensions are in mm

Fig. 3

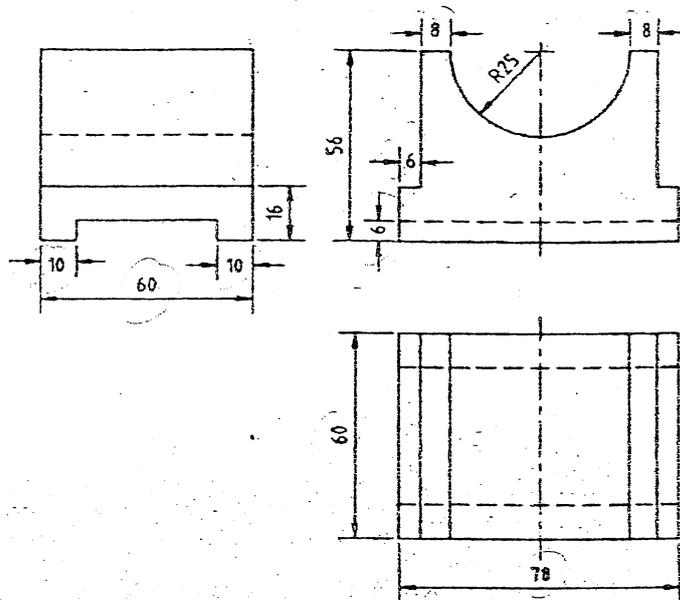


Exam.	Regular/Back		
Level	BE	Full Marks	40
Programme	BCE, B.Agr.	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

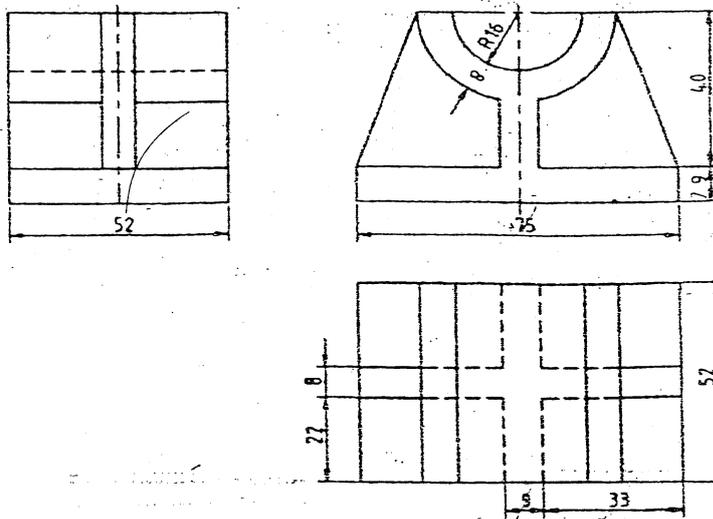
Subject: - Engineering Drawing II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt *All* questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Dimensions in mm if not specified.
- ✓ Assume suitable data if necessary.

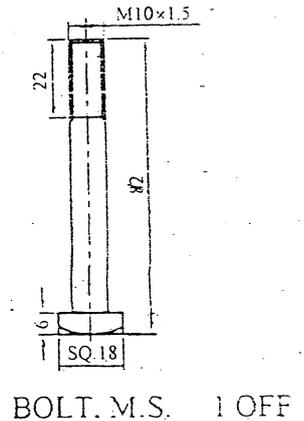
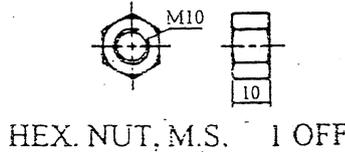
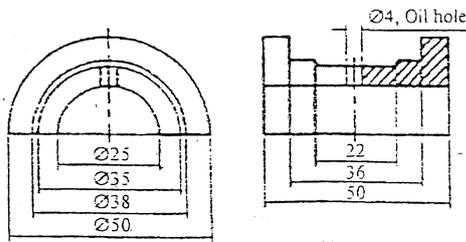
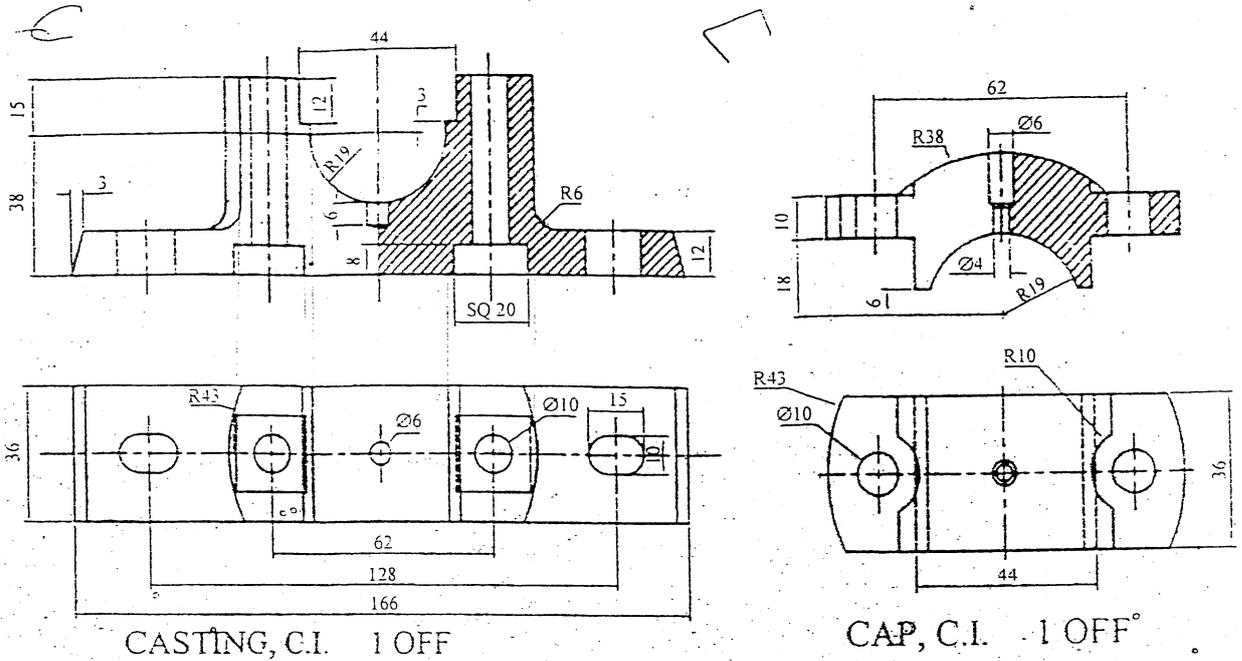
1. Orthographic views of an object are shown in figure. Draw its isometric view. [9]



2. Orthographic views of an object are shown in figure. Draw its oblique view. [6]



3. The production drawing of plumber block is shown in figure. Draw its assembled half sectional front view. [15]



BRASS, G.M. 1 OFF

LOCK NUT, M.S. 1 OFF

BOLT, M.S. 1 OFF

4. Determine the limits of dimensions and type of fit designated by H8/d9 for the basic size of 50mm, assuming fundamental deviation for H and d respectively as 0 μ m and 80 μ m below the basic size line and international tolerance grades for 8 and 9 as 39 μ m and 62 μ m respectively. [5]

OR

Sketch the plan and sectional elevation of double riveted zig-zag lap joint.

5. Draw the standard symbols for the followings: [5]

- | | |
|------------------------|------------------|
| a) Seam Weld | b) Field Weld |
| c) Union | d) Globe Valve |
| e) Channel Section | f) I Beam |
| g) Two way Switch | h) 3-phase Motor |
| i) Depression Contours | j) Capacitor |

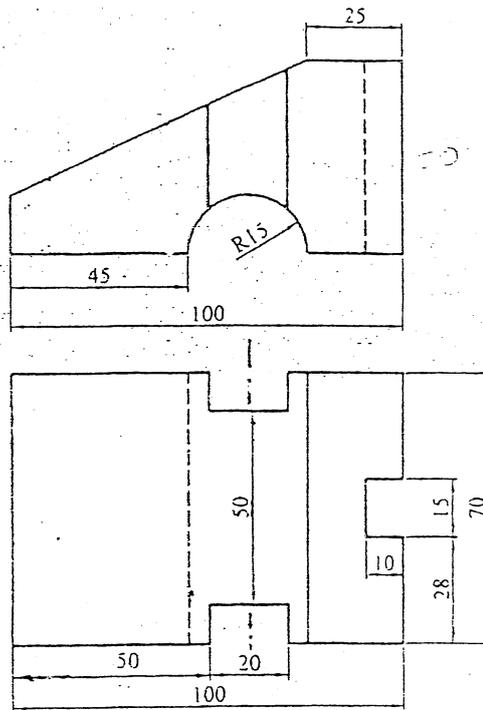
2066 Magh

Level	BE	Full Marks	40
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

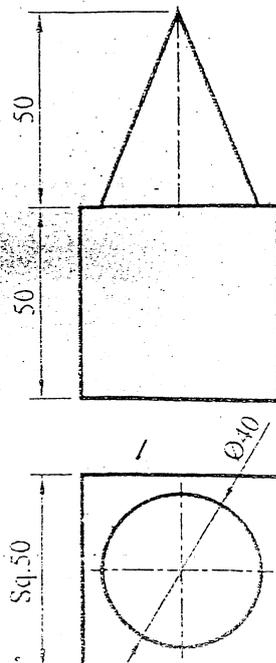
Subject: - Engineering Drawing II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Orthographic views of an object are shown in given figure. Draw its oblique view. [9]

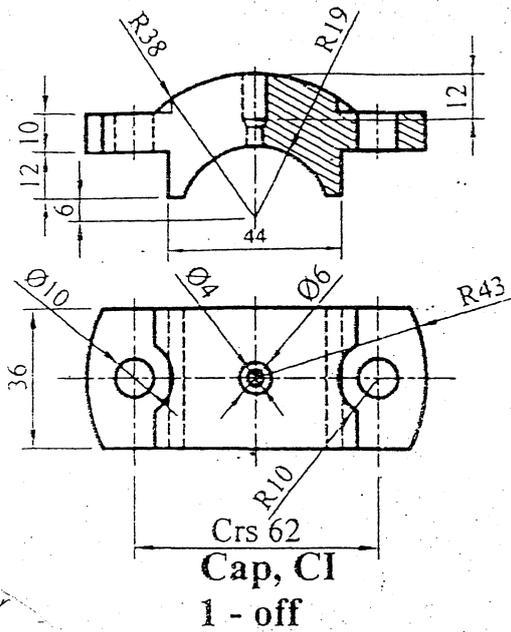


2. Draw the oblique view of object from the given orthographic views as shown in given figure. [6]



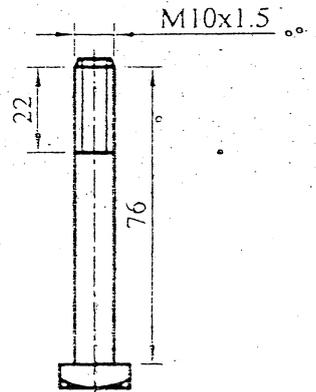
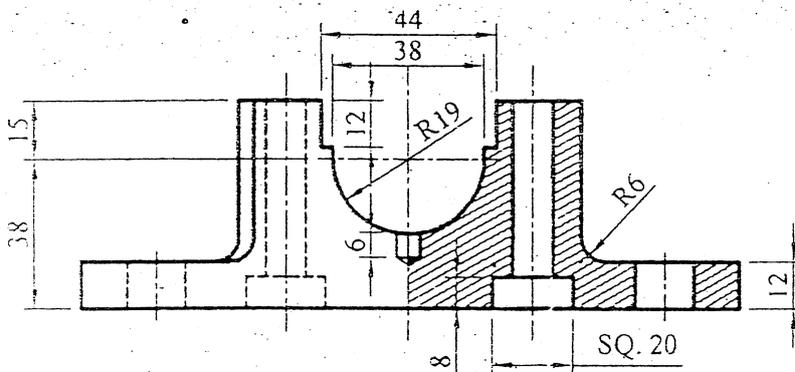
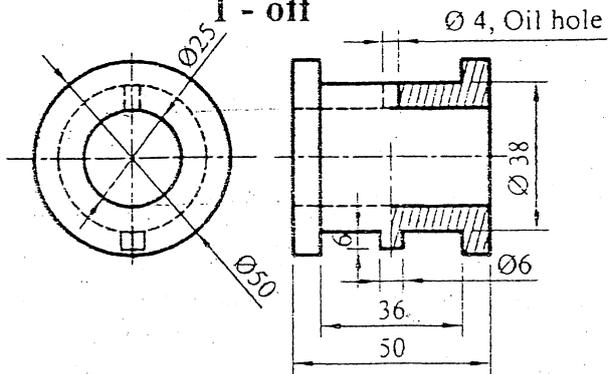
Plummer block in given figure.

[15]



Brass, GM

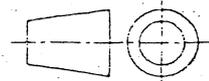
1 - off



Sq. M10x1.5 Bolt
2 - off



Sq. M10x1.5 Nut
2 - off



All dimensions are in mm.

4. Determine limits, tolerance, allowance and type of fit designated by 55T8/h5. The value of fundamental deviation 'T' is -0.024mm . International tolerance grades values for 8 and 5 are 0.031mm and 0.013mm respectively. [5]
5. Draw the standard symbols for the following: [5]

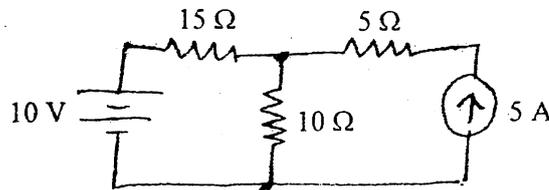
a) Seam Weld	b) Cap
c) Incandenscent lamp	d) Surface produced by casting
e) Nipple	f) Tubular structural member
g) Resistor	h) Depression counter
i) Bell	j) End view of external thread

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

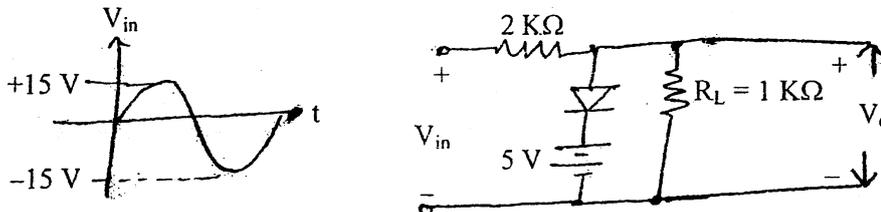
Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

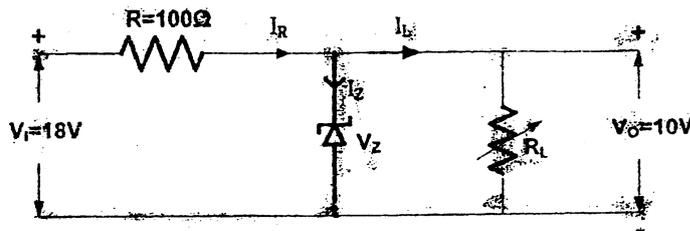
1. Define active and passive circuit component. Determine the color code of the following resistor $75\text{ K}\Omega \pm 10\%$. [2+2]
2. Determine the current through $10\ \Omega$ resistance using Thevenin's theorem. [4]



3. What is a filter? Explain the types of filter with necessary diagrams. [1+3]
4. Explain large signal models of PN junction diode. [4]
5. Define clipping circuits. Draw the output waveform of circuit shown below. Assume real silicon diode. [2+2]



6. Find the Zener current in the given circuit when $R_L = 1.2\text{ K}\Omega$. Assume $V_Z = 10\text{ V}$. [4]



7. Explain the common emitter configuration circuit of npn transistor with the help of input and output characteristics. [6]

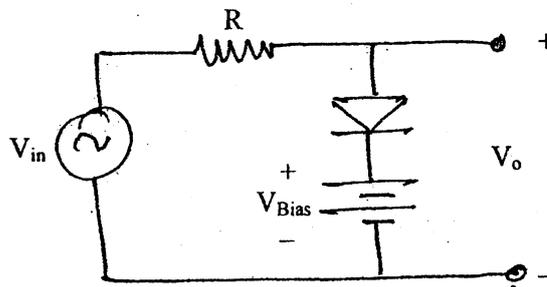
8. Explain the working principle of N channel depletion type MOSFET with necessary diagrams. [6]
9. State any four properties of an ideal op-amp. Design a summing amplifier using Op-Amp to get the output voltage $V_0 = -V_1 + 2V_2 + 3V_3$. [2+3]
10. Explain how square wave can be generated using Op-Amp and write the relation for frequency of oscillation. [4+1]
11. Define communication system and draw the complete block diagram of communication system. [2+3]
12. What is optical fiber? Explain the advantages of optical fiber communication over traditional communication system. [2+3]
13. Simplify the expression using K-map, $Y = A'BC' + ABC' + ABC$. [3]
14. Explain the operation of SR-flip flop with necessary diagrams and characteristics table. [6]
15. (a) $(10101.101)_2 = (?)_{10}$ (b) $(9001180)_{10} = (?)_{BCD}$ (c) $(2AB.5E)_{16} = (?)_8$ [1×3]
16. What is instrumentation system? Explain the instrumentation system with the help of simple block diagram. [1+3]
17. Write short notes of any two: [2×4]
 - a) Data Logger
 - b) DMM
 - c) Strain Gauge

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All Except (B.Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

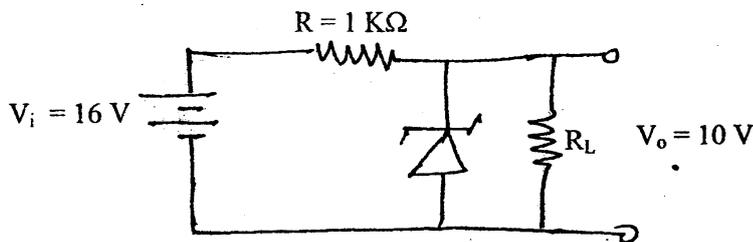
Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

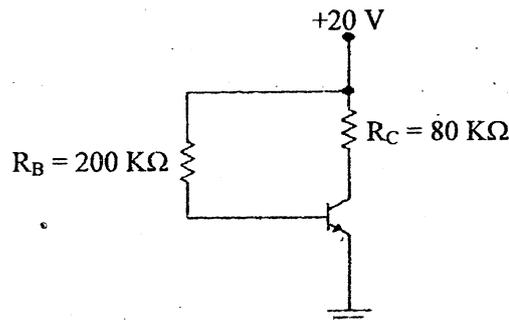
1. What do you mean by filter? Explain the RC low pass and high pass filter with corresponding transfer function and magnitude. [1+4]
2. State Thevenin's Theorem. Write down the steps for determining V_{th} and R_{th} with necessary circuit diagrams. [1+4]
3. What is rectification? Explain the operation of half wave rectifier with necessary diagrams. [1+4]
4. What are clippers? Draw the sinusoidal waveform of the following circuit and indicate the output voltage. Assume diode is ideal. [1+4]



5. Find the zener current from the given zener diode network when $R_L = 3\text{ K}\Omega$ and $V_o = 10\text{ V}$. [5]



6. For the given circuit with $\beta = 75$, determine I_B , I_C and V_{CE} . [2+2+2]



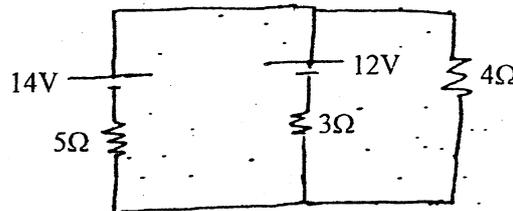
7. Explain the construction and working principle of enhancement type MOSFET? [6]
8. Explain the concept of feedback theory. Describe the working principle of square wave oscillator circuit using op-amp. [2+4]
9. State any 4 important properties of ideal Op-Amp. Draw the circuit diagram of differentiator using Op-Amp and show that output is the differentiation of input signal. [2+4]
10. What is modulation? Explain AM and FM modulated wave. [1+2+2]
11. What do you mean by electromagnetic waves? How are they propagated? Explain. [2+3]
12. Perform the following: [4×1]
- a) $(375.37)_8 = (?)_{16}$
 - b) $(169.03125)_{10} = (?)_2$
 - c) $(905)_{10} = (?)_{BCD}$
 - d) Subtract $(25)_{10}$ from $(49)_{10}$ using 2'S complement method
13. Simplify the following Boolean expression using K-map and realize it by using universal gate of your interest. [3+2]
- $$F(x, y, z) = xy + \bar{x}z + yz$$
14. Explain SR flip-flop with circuit. [4]
15. What is instrumentation system? Describe the instrumentation system with block diagram. [4]
16. Explain briefly about remote control or digital multimeter with necessary diagrams. [4]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

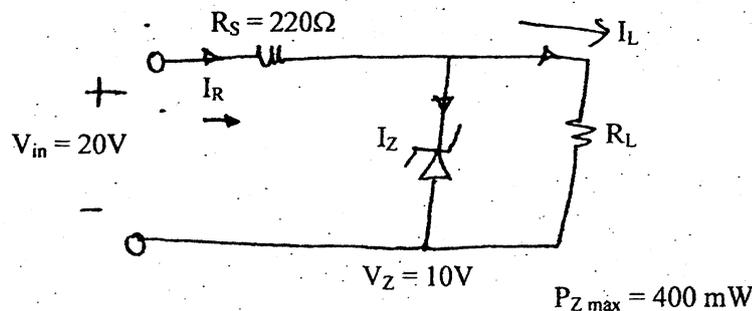
Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. State superposition theorem. In the following figure find the current flow in 4 ohm resistor using superposition theorem. [2+4]



2. Explain the principle of operation of RC low pass filter with necessary diagrams and derivation. [4]
3. Explain the working principle of full wave bridge rectifier circuit with the help of necessary circuit diagrams and expressions. [6]
4. Determine V_L , I_L , I_Z and I_R for the network shown in figure below for following condition. [3+3]
- a) If $R_L = 180 \Omega$
 b) If $R_L = 470 \Omega$



5. Define DC load line? Explain the common emitter configuration circuit with the help of input and output characteristics curve. [2+4]
6. Explain the construction and working principle of MOSFET. [6]
7. Write the four properties of ideal operational amplifier. ✓ [2+4]
8. Explain how square wave can be generated using Op-Amp. [6]

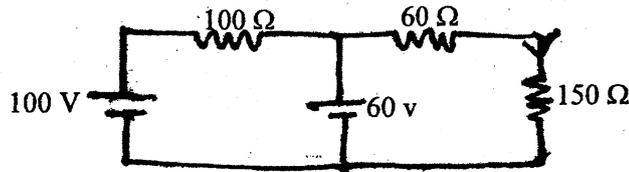
9. Define communication system. Explain amplitude modulation communication system with the help of necessary block diagrams. [6]
10. Discuss the role of antenna in communication system. What are the advantages and disadvantages of optical fiber communication? [2+4]
11. Draw the circuit of X-OR gate using NAND gates only. Perform the subtraction using 2's complement method. [2+2]
 $42_{(10)} - 115_{(10)}$
12. Simplify the expression using k-map [4]
 $F(x, y, z) = xyz + x'y'z + xy'z' + x'y'z' + x'yz$
13. Discuss the operation of S-R flip flop. [4]
14. Write short notes: (any two) [5×2]
- a) Clipper circuit
 - b) Strain gauge transducer
 - c) Data logger

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Find the current I in 150 Ω resistor using thevenius theorem. [6]



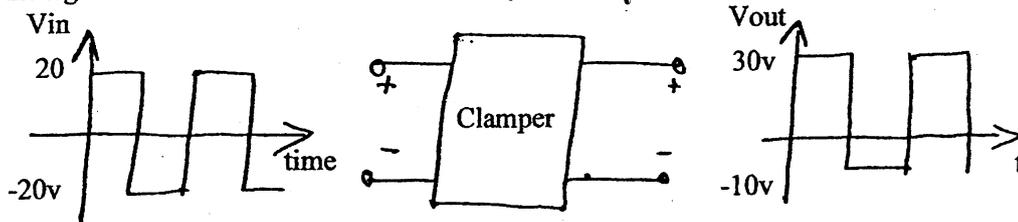
2. Find the value of resistor from following colour code. [2]

a) Red Orange Green Silver b) Yellow Black Gold Gold

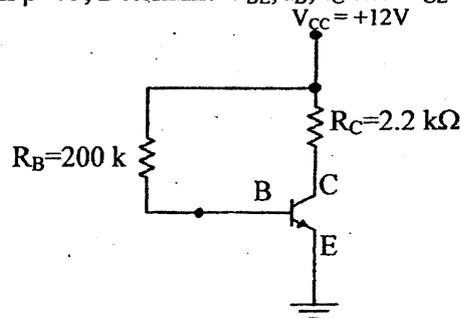
3. Explain the operation of RC high pass filter circuit with the help of necessary diagrams and figures. [4]

4. Describe IV characteristics of PN Junction diode. [6]

5. What is a clamper circuit? Design a clamper circuit to perform the function indicated in the figure below. [2+4]



6. For the given circuit with $\beta=75$, Determine V_{BE} , I_B , I_C and V_{CE} . [6]



7. Explain how BJT can be used as a switch. What are the difference between MOSFET and BJT? [4+2]

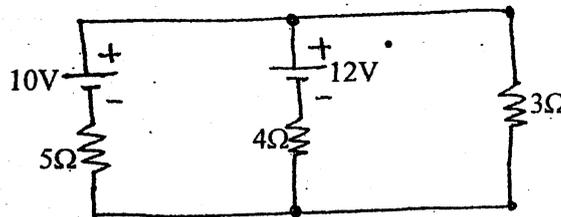
8. Explain the concept of virtual ground in op-amp. Design a summer circuit using op-amp to get the output voltage as: $V_0 = -(V_1 + 10V_2 + 25V_3)$ [2+4]
9. How do you define positive feedback? Draw the circuit for Wein bridge oscillator and explain the principle of operation. [2+4]
10. What are the advantages of optical fiber communication system? Draw and label the diagram of optical fiber. [3+3]
11. Explain why modulation is needed in Communication System. Mention any three parameters of antenna. [3+3]
12. Simplify the given function using K-map method. $F(A, B, C) = \Sigma (0, 1, 2, 5) + D (3, 4, 6)$ and implement the simplified circuit using NAND only. [3+3]
13. What is the difference between combinational and sequential circuit. Discuss JK flip-flop with the help of logic diagram. [2+6]
14. Write short notes on: (any two) [3×2]
- a) Data logger
 - b) Regulated power supply
 - c) Digital Multi-meter

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All (Except B, Arch)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

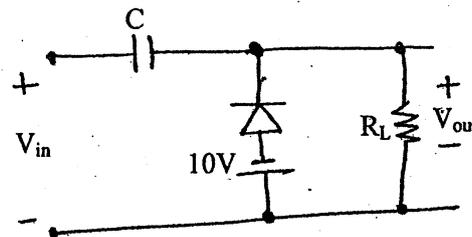
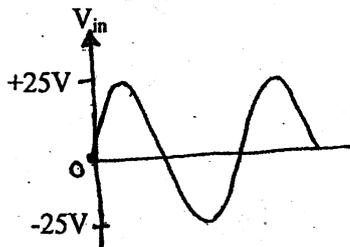
Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

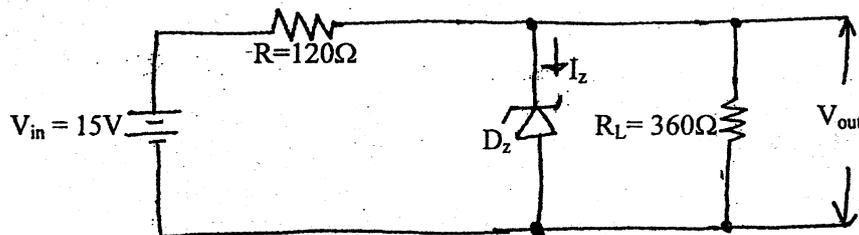
1. Define transconductance and voltage gain with reference to BJT. [3]
2. Draw RC high pass filter circuit and its characteristics graph. [2]
3. Find current flow in 3Ω resistance. Use superposition theorem to solve the problem. [5]



4. What is clamping circuit? Find the output waveform of the given circuit. [1+3]



5. Deduce AC resistance of PN junction diode at forward biased region. [3]
6. Draw bridge rectifier circuit and its output waveform. Assume input is Sinewave voltage. [3]
7. Find I_z , assuming $V_z = 9V$. [3]



8. Find the volume of collector current, Q-point, DC load line for common emitter circuit having $V_{CC} = 15V$, $R_C = 10K\Omega$, $I_B = 10\mu A$ and $\beta = 50$. [5]

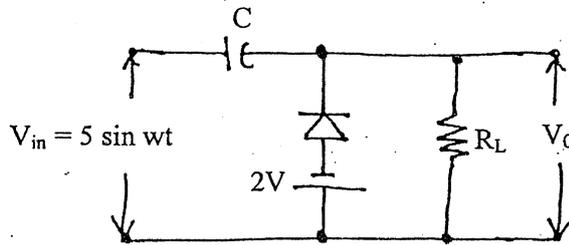
9. Draw the circuit diagram and I-V characteristic curve to investigate output static characteristics of common emitter amplifier configuration. [3]
10. Describe the operation of CMOS NOT-gate circuit. [4]
11. State four important properties of ideal op-amp. Draw the circuit diagram of a differentiator using op-amp and show that the output is the derivative of the input. [2+4]
12. Describe the operation of Wien bridge RC-sinewave Oscillator. State Barkhausen criteria. [4+2]
13. Draw the block diagram of communication system and explain each block. [4]
14. Define amplitude modulation and frequency modulation and draw the necessary waveforms. [2+3]
15. State DeMorgan's theorems with example in each case. [4]
16. a) Verify the following: [2+2]
- i) $AB + \bar{A}C = (A+C)(\bar{A}+B)$ ii) $XY + \bar{X}Z + YZ = XY + \bar{X}Z$
- b) Find: $(15)_{10} - (20)_{10} = ?$, use 2's complement method. [2]
17. Draw and explain the block diagram of data logger and remote control. [5+5]
18. Define encoder. Draw truth tables of NAND and XOR gates. [2+2]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

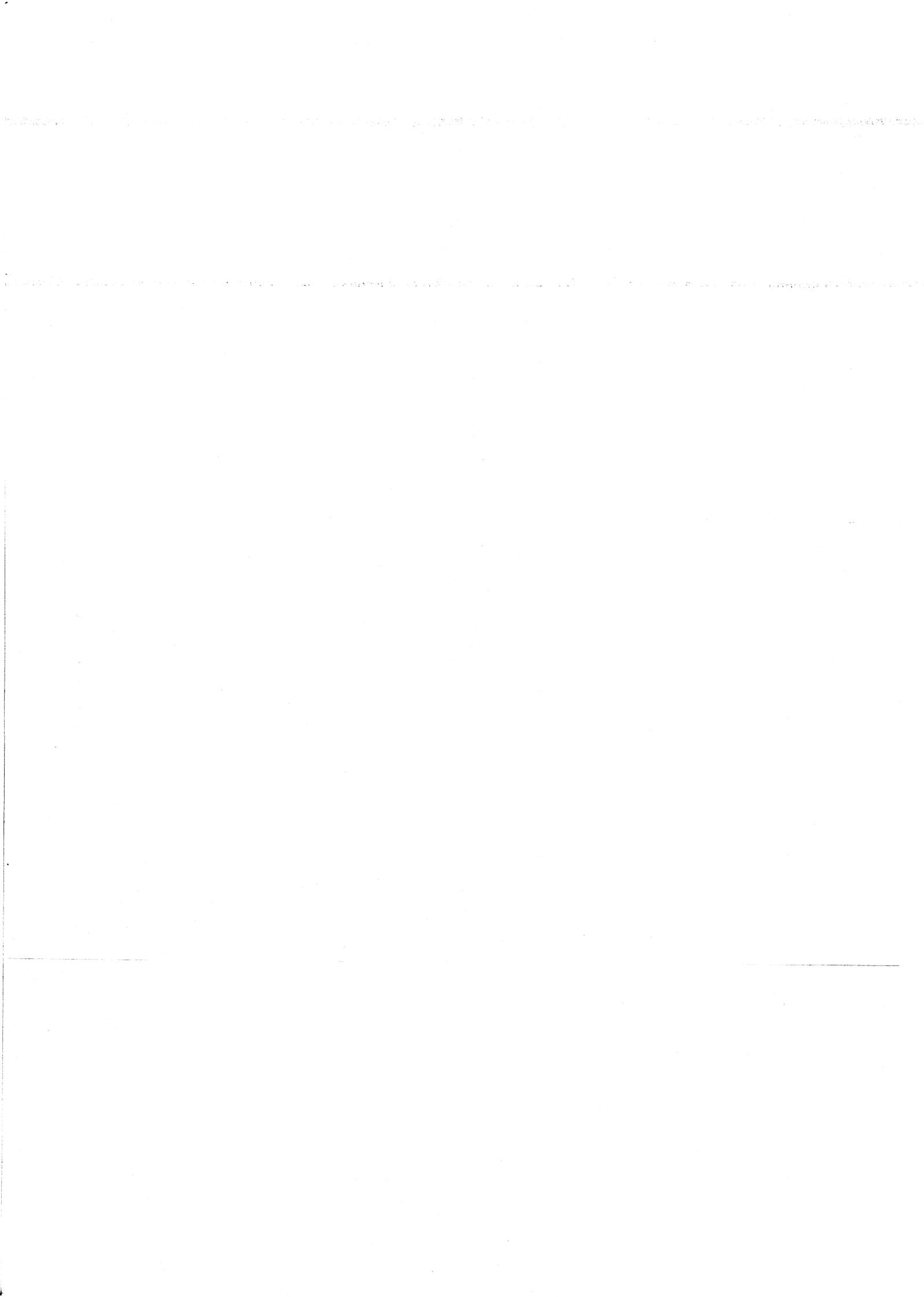
Subject: - Basic Electronics Engineering

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What do you mean by a filter circuit? Explain in brief about RC high pass filter. [1+3]
2. Define capacitance. Find the equivalent capacitance when two capacitors of capacitance C_1 and C_2 are connected in series. [1+3]
3. Explain the small signal model of PN junction diode and derive the expression for AC or dynamic resistance. [8]
4. What is a clipper circuit? Find the output waveform for the following circuit. [1+3]



5. In BJT circuit if $V_{CC} = 10V$, and $R_C = 8k\Omega$, draw the dc load line. Determine the Q-point (operating point) for zero input signal if $I_B = 15\mu A$ and $\beta = 40$. [8]
6. Why BJT is a bipolar and MOSFET is a unipolar device? And draw the circuit diagram of differential amplifier using BJT. [2+2]
7. Design the summing amplifier using Op-Amp to get the output voltage: $V_o = 3V_1 + 2V_2 + V_3$. [6]
8. Explain how square wave can be generated using Op-Amp and write the relation for frequency of oscillation. [4]
9. Define communication system and draw the complete block diagram of communication system. [2+4]
10. What is optical fiber? Write short notes on optical fiber. [1+3]
11. Explain the working principle of n-channel Enhancement type MOSFET. [7]
12. Subtract $(111)_2$ from $(110)_2$ using 2's complement method. Draw the circuit of AND gate using NOR gates only. [3+3]
13. Explain the operation of SR-flip flop with necessary diagrams and characteristic table. [6]
14. Write short notes on: (any three) [3x3]
 - a) Regulated power supply.
 - b) Transducer
 - c) Oscilloscope
 - d) Data logger

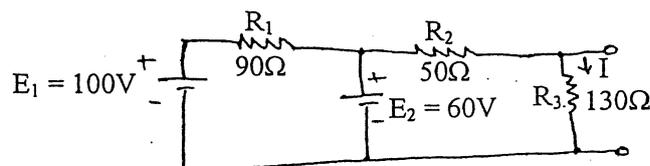


Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except. B. Arch)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Basic Electronics Engineering

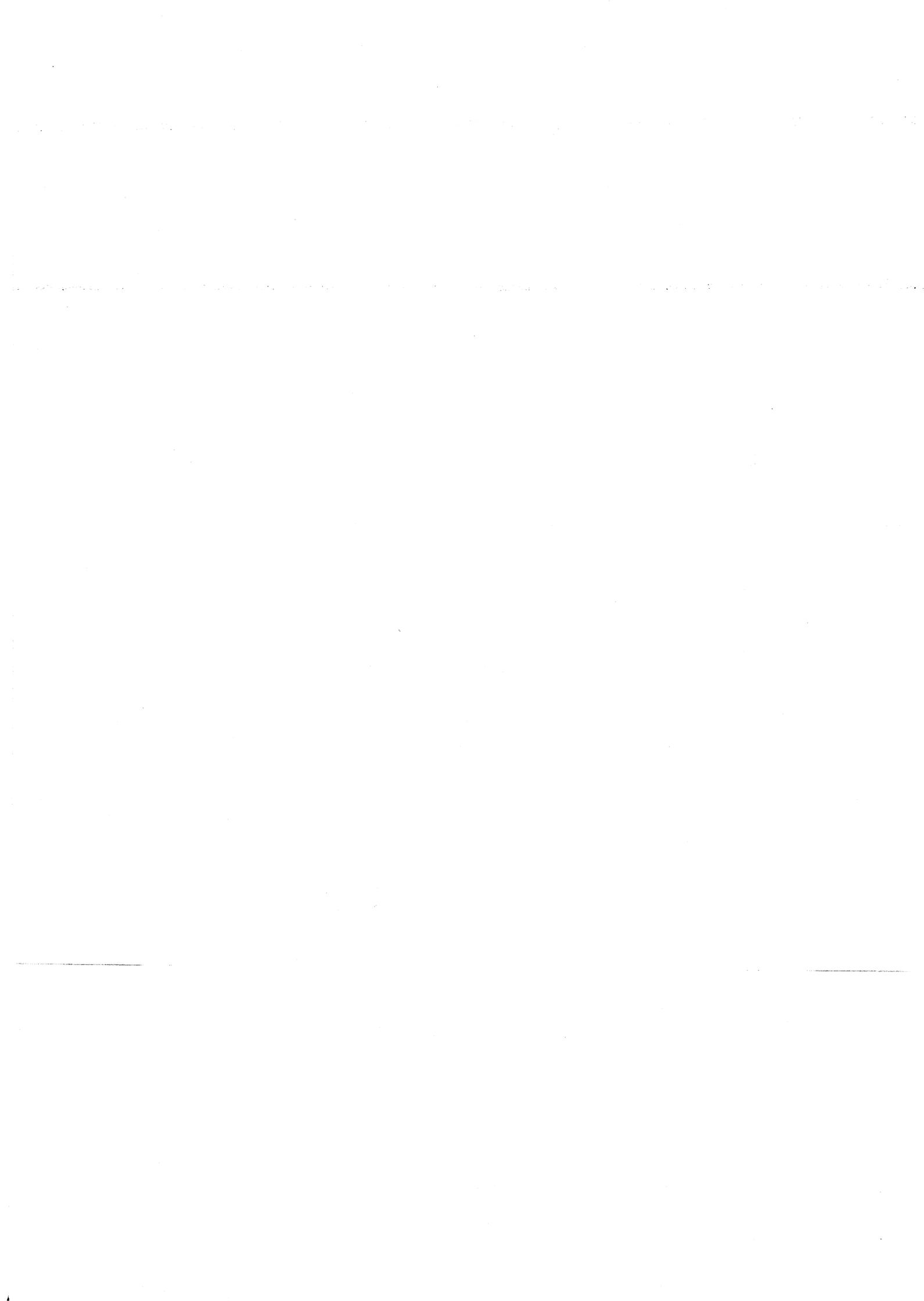
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Describe the principle of Thevenins theorem by solving following problem. [7]



Find the current I in R_3 .

- b) Draw the circuit diagram of RC low filter and explain its operation with the help of frequency dependent output waveform. [7]
2. a) Draw and explain the I-V characteristics curve of P-N junction diode for forward and reverse bias region. [7]
- b) Draw Zener voltage regulator circuit and explain clearly the working principle of this circuit to produce a regulated dc output. [7]
3. a) Describe output characteristics of common emitter configuration with the help of circuit diagram and IV characteristics graph. [7]
- b) Describe the construction and working principle of N Channel E-MOSFET. [7]
4. a) State four important properties of ideal op-amp. Draw the circuit diagram of differentiating amplifier using op-amp and derive the expression for V_{out} . [2+5]
- b) i) Draw the circuit diagram of Wien Bridge oscillator circuit for sinusoidal wave form. [4+3]
 ii) Draw square wave oscillator circuit.
5. a) Perform the conversion of the following: [6]
- i) $(10111.101)_2 = (?)_{10}$
 ii) $(AFC.00)_{16} = (?)_8$
 iii) $(901)_{10} = (?)_{BCD}$
- b) Simplify the expressions and draw the circuits [6]
- i) $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C$
 ii) $A\bar{C} + ABC + A(C+A\bar{C})$
6. Write short notes on any two: [2×6]
- a) Strain Gauge
 b) $\lambda/2$ Dipole Antenna
 c) Transducer
 d) Amplitude Modulation (AM)

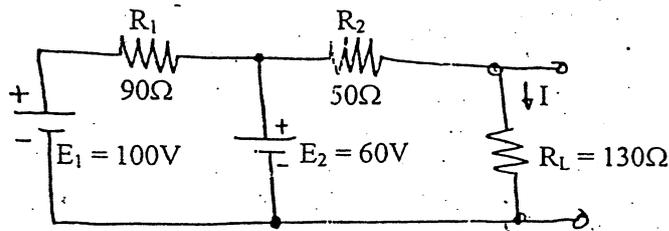


Exan.	New Back (2066 Batch Only)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Basic Electronics Engineering

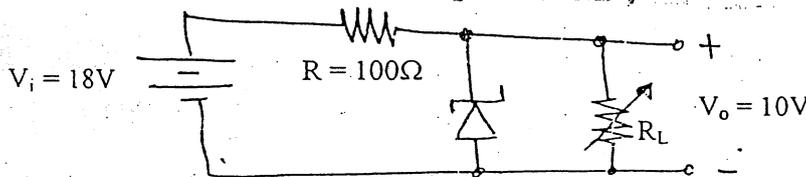
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Describe the principle of superposition theorem by solving following problem. [5]



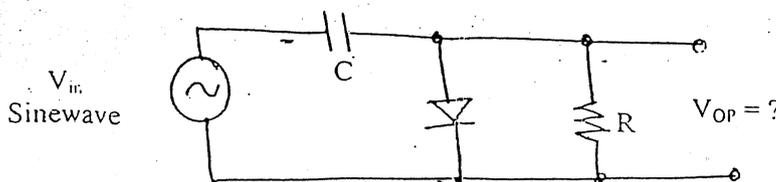
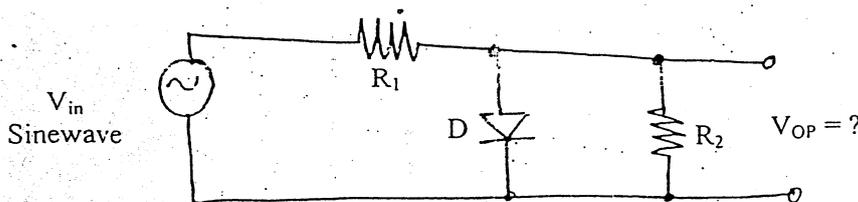
Find current I through R_L .

- b) Explain the concept of voltage gain and transconductance using block diagram. [3]
2. a) Describe the working principle of PN junction diode with the help of circuit diagram and its IV characteristics graph. [3]
- b) Find zero current in the given circuit when $R_L = 1.2k\Omega$. [3]

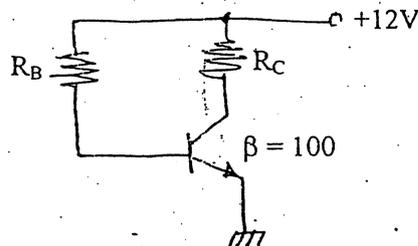


Assume $V_Z = 10V$.

3. a) Draw bridge rectifier circuit and its output waveform with output load resistor (R_L) connected. Express the ripple factor if smoothing capacitor, C is connected to the circuit. [3]
- b) Draw output waveforms of the following circuits and indicate the peak output voltage. Assume diode is ideal. [3]



4. a) Draw basic differential amplifier circuit and indicate its input and output voltage waveforms. [2]
 b) Describe the operation of CMOS NOT-gate circuit. [4]
 c) Find R_B and R_C in the given circuit. Given data are: $I_C = 1.2\text{mA}$, $V_{CE} = 6\text{V}$ and $\beta = 100$. [4]



5. a) State six important properties of ideal opamp. [3]
 b) Derive voltage gain for noninverting amplifier using ideal opamp. [3]
 c) Describe the operation of square wave generator using opamp. [4]
 6. a) Define antenna and electro magnetic wave (EMW) propagation. [4]
 b) Explain and enlist wired and wireless communication systems. [4]
 c) Draw a block diagram of AM super heterodyne radio receiver. [2]
 7. a) Why NOR and NAND gates are called universal gates? Explain with examples. [3]
 b) Draw a block diagram of edge triggered, with preset and clear facilities, D-flip flop and its truth table. State one important advantage over RS flip flop. [3]
 8. a) State and prove De Morgan's Theorems. [3]
 b) Convert the followings: [3]
 i) 33_{10} to binary
 ii) $(1100\ 0011)_2$ to decimal
 iii) Add $(1001)_2$ and $(0111)_2$
 9. a) Draw the block diagram of (CRO) oscilloscope. And explain its working function. [4]
 b) Draw the block diagram of DMM (Digital Multimeter). And explain how it measures DC voltage, DC current and resistance. [6]
 10. Write short notes on: (any two) [2x4]
 a) Graphical analysis of diode circuit
 b) Shift register and counter
 c) E-MOSFET

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics (SH452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Differentiate between linear and angular harmonic motion. Prove that three exits four collinear point in a bar pendulum.

OR

Derive a relation for current floping in the circuit containing a resistor, an inductor and a capacitor in series with a sinusoidally varying emf. Find the condition for current responce.

2. A simple pendulum of length 40 cm and mass 50 gm is suspended in a car that is traveling with a constant speed 40 m/s around a circle of radius 100 m. If the pendulum undergoes small oscillations in a radial direction about its equilibrium position, what will be its frequency of oscillation?
3. Write a plane progressive wave equation for a wave propagating along the +ve x-axis. Prove the following relations:
 - i) Particle velocity at a point = - (Wave velocity) X (Slope of the displacement curve at that point)
 - ii) Particle acceleration at a point = (Wave speed)² X (Curvature of the displacement curve at that point)
4. What is chromatic aberration? Show that longitudinal chromatic aberration is equal to (i) $\omega \times f$, when object is at infinite and (ii) $\frac{\omega \times v^2}{f}$, when object is at finite. Where symbols have their usual meaning.
5. What are Newton's rings? How can you determine the refractive index of given liquid using Newton's rings experiment?

OR

Differentiate between quarter wave plate and half wave plate. Use the reference of double refraction to describe with diagram, how you distinguish positive and negative crystal.

6. What is the difference between the resolving and dispersive power of the plane transmission grating? Show that both resolving and dispersive powers are directly proportional to order of the spectrum.
7. A sugar solution in a tube of length 200 mm produces an optical rotation 13°. The solution is then diluted to (1/3) of its previous solution concentration. Find the optical rotation produced by 35 cm long tube containing the diluted solution.

2

8. An optical fiber has a numerical aperture (NA) of 0.22. The core has refractive index 1.60. Calculate the acceptance angle in water that has refractive index of 1.33. Also, calculate the critical angle at core cladding interface.
9. Define electric dipole. Charges of an electric dipole are replaced by identical charges; find the electric field and potential at a point on its axial line.

OR

Derive a relation for electric field at a point on the axis of a positively charged plastic ring. Show that if an electron is constrained within the axis of ring, motion of electron will be SHM.

10. If a disk of radius 2.5 cm has a surface charge density of $8.6 \mu\text{C}/\text{m}^2$ on its upper surface. What is the electric field (i) at a surface of the disk and (ii) at a point on the central axis at a distance 15 cm from the disk?
11. A parallel plate capacitor whose capacitance C is 13.5 pF is charged by a battery to a potential difference $V = 12.5$ V between its plates. The charging battery is now disconnected and a porcelain slab ($k = 6.50$) is supplied between the plates. (a) What is the potential energy of the capacitor before the slab is inserted (b) What is the potential energy of the capacitor –slab device after the slab is inserted?
12. A copper wire of cross-section area $3 \times 10^{-6} \text{m}^2$ carries a steady current of 60A. Assuming one electron per atom. Calculate (i) free electron density and (ii) average drift velocity. Given, Density of Cu = $8.9 \times 10^3 \text{kg}/\text{m}^3$, Molar mass of Cu = 64 and Avogadro's Number = $6.02 \times 10^{23}/\text{mole}$.
13. Determine the energy stored in an inductor. Also, determine the energy density in magnetic field.

OR

Obtain an expression for magnetic field intensity due to a circular coil carrying current at its axial point. Compare the result with that due to short bar magnet.

14. Suppose a cyclotron is operated at an oscillator frequency of 15 MHz and has a dee of radius 55 cm (i) What is the resulting kinetic energy of deuteron? (ii) What is the magnetic field needed for deuteron to be accelerated in the cyclotron? Given: mass of the deuteron = $3.34 \times 10^{-27} \text{kg}$.
15. Write Maxwell's equations for non conducting medium. Using these equations determine the electromagnetic wave equation in terms of magnetic field for a non conducting and an-isotropic medium having finite permittivity (μ) and finite permeability (ϵ). Hence prove that the velocity of electromagnetic wave is equal to velocity of light in free space.
16. What is the physical meaning of wave function? Derive the Schrodinger time independent wave equation.

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics (SH452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Develop and solve the differential equation of damped harmonic oscillator subjected to a sinusoidal force. Then obtain expression for its maximum amplitude and quality factor. [5]

OR

Obtain an expression for current in a driven LCR circuit and discuss how the current leads or lags the applied voltage in phase:

- a) When the net reactance in circuit is inductive and
- b) When the reactance in circuit is equal to resistance. Illustrate it with the help of a figure.

2. A circuit has $L = 2 \text{ mH}$, $C = 1.6 \mu\text{F}$ and $R = 1.5 \Omega$. (a) After what time t will the amplitude of charge oscillations drop to one half of its initial value. (b) To how many periods of oscillations does this correspond? [5]

3. Calculate the reverberation time for a hall of volume 1400 m^3 , which has seating capacity of 110 persons with full capacity of audience and when audience are occupying only cushioned seats. The relevant data for the hall are: [5]

SN	Surface	Area (m^2)	Coefficient of absorption
1	Plastered Wall	98	0.03
2	Plastered Ceiling	144	0.04
3	Wooden Door	15	0.06
4	Cushioned Chairs	88	1.00
5	Audience	150	4.70

4. Prove that the condition for achromatism for the combination of two lenses of focal length f_1 and f_2 having dispersive power w_1 and w_2 placed at a separation x is [5]

$$\frac{w_1}{f_1} + \frac{w_2}{f_2} = \frac{x}{f_1 f_2} (w_1 + w_2)$$

Also prove that the separation between the lenses is equal to the focal length if $f_1 = f_2$.

5. In He-Ne laser, the lasing action is due to Ne gas. Then what is the role of the gas in it? Explain how the He-Ne laser works with a suitable energy level diagram on the basis of four level scheme for its action. [5]

6. Two sources of intensities $4I$ and I are used in an interference experiment. Obtain the intensities at points where the waves from two sources superimpose with a phase difference of (a) 0 (b) $\frac{\pi}{2}$ (c) π . [5]

OR

Explain the dispersive and resolving power of a diffraction grating. Prove that the ratio of dispersive power to resolving power is equal to the ratio of half width of peak and wavelength of incident light.

7. Derive the necessary formula for linearly, circularly and elliptically polarized light when light is emerged out of the doubly refraction crystal. [5]
8. What are Newton's rings? Derive the relation for the diameter of bright rings. What is the difference between the rings observed by reflected light and by transmitted light? Explain how does the pattern appear when white light is used? [5]
9. Define electric displacement vector. Develop a relation between electric displacement vector, electric field and polarization. Also prove that induced charge in dielectric is always less than free charge. [5]

OR

A dielectric sphere of radius R is charged uniformly. Obtain expressions for electric field intensity (a) outside (b) at the surface and (c) inside the sphere.

10. To similar balls each of mass m are hung from silk threads of length l and carry similar charges q . Assume that the angle made by each thread with vertical, θ is small. Show that

$$x = \left(\frac{q^2 l}{2\pi \epsilon_0 mg} \right)^{\frac{1}{3}},$$

where x is separation between the balls. Also calculate the charge q on the hung mass if $l = 1.2$ m, $m = 20$ g and $x = 3$ cm. [5]

11. The parallel plates in a capacitor, with a plate area of 8.5 cm^2 and air filled separation of 3 mm are charged by a 6 V battery. They are then disconnected from the battery and pulled apart to a separation of 8 mm. Neglecting fringing, find (a) the potential difference between the plates (b) the initial energy stored and (c) final energy stored. [5]

OR

A capacitor discharges through a resistor R . (a) After how many times constant (τ_c) does it charge fall to one half of its original value? (b) After how many time constants does the stored energy drop to half of its initial value?

12. What is Biot-Savart law? Derive an expression for flux density due to a current carrying circular loop at its axial point. [5]
13. If a parallel plate capacitor with circular plate be charged, prove that the induced magnetic field at a distance r in the region between the plates be [5]

$$B = \frac{1}{2} \mu_0 \epsilon_0 r \frac{dE}{dt} \text{ for } r \leq R \text{ and}$$

$$B = \frac{1}{2} \frac{\mu_0 \epsilon_0 R^2}{2r} \frac{dE}{dt} \text{ for } r \geq R$$

14. In a Hall-effect experiment, a current of 3 A sent lengthwise through a conductor 1 cm wide, 4 cm long and $1 \mu\text{m}$ thick, produces a transverse Hall voltage of $10 \mu\text{V}$, when a magnetic field of 1.5 T is passed perpendicularly through the thickness of the conductor. Calculate (a) drift velocity of the charge carriers and (b) the number density of charge carriers. [5]
15. Define poynting vector and develop an expression of it interms of electric and magnetic fields. Using the poynting vector calculate the maximum electric and magnetic fields for sun-light if the solar constant is 1.4 KW/m^2 . [5]
16. A beam of electrons having energy of each 3 eV is incident on a potential barrier of finite height 4 eV. If the width of the barrier is 20 \AA , calculate the percentage transmission of the beam through the barrier. [5]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics (SH452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Derive a relation to determine the radius of gyration of a compound pendulum. Why determination of the acceleration due to gravity is more accurate from a compound pendulum than a simple pendulum?

OR

Define the quality factor (Q). Derive a relation of quality factor (Q) from the damped harmonic motion and show that the quality factor (Q) is inversely proportional to damping constant (b).

2. An oscillatory motion of a body is represented by $y = ae^{i\omega t}$ where y is displacement in time t, a is its amplitude and ω is angular frequency. Show that the motion is simple harmonic.
3. What is Ultrasound? How these waves are produced? Differentiate such waves from ordinary sound wave.
4. Why colours are observed when soap bubble is exposed to sunlight? Show that the consecutive bright or dark fringes are observed when the thickness of the film increases by $\frac{\lambda}{2}$ in an inclined plane.

OR

What is plane diffraction grating? How is it used to find the wavelength of a monochromatic light experimentally?

5. What is an optical fiber? How is it made? Write down the main differences between step index and graded index multimode optical fibers with well diagrams.
6. A 200 mm long glass tube is filled with a solution of sugar, containing 15 gm of sugar in 100 ml of water. The plane of polarized light, passing through this solution, is rotated through $25^{\circ}17'$. Find the specific rotation of sugar.
7. Two thin converging lenses of focal lengths 0.2 m and 0.3 m are placed coaxially 0.1 m apart in air. An object is located 0.6 m in front of the lens of smaller focal length. Find the position of principal points and that of image.
8. What is double refraction? Show that a beam of plane polarized light is converted into elliptically polarized light when it passes through a quarter-wave plate.

9. Obtain an expression for electric field at an axial distance x from the centre of the flat circular disc of radius R that carries a uniform surface charge density σ . Extend your result to calculate potential at a distance x .

OR

A thin ring made of plastic of radius R is uniformly charged with linear charge density λ . Calculate the electric field intensity at any point at an axial distance Y from the centre. If electron is constrained to be in axial line of the same ring, show that the motion of electron is simple harmonic.

10. A copper strip 2.5 cm wide and 1.5 mm thick is placed in magnetic field with $B = 2.5$ T perpendicular to the plane of the strip and away from the reader. If a current of 250 A is set up in the strip, what Hall potential difference appears across the strip? Charge density is copper $= 8.4 \times 10^{28}/\text{m}^3$.
11. Compare Ampere's law with Biot Savart law. Obtain expressions for magnetic field intensity inside and outside the long straight wire carrying current.
12. A spherical drop of water carrying a charge of 30 pC has a potential of 500 V at its surface (with $V = 0$ at infinity). (a) What is the radius of the drop? (b) If two such drops of the same charge and radius combine to form a single spherical drop, what is the potential at the surface of the new drop?
13. Calculate the displacement current between the capacitor plates of area $1.5 \times 10^{-2} \text{ m}^2$ and rate of electric field change is $1.5 \times 10^{12} \text{ V/ms}$. Also find the value of displacement current.
14. Obtain expressions for growth and decay of charges in the RC circuits. Explain how you will measure experimentally the capacitance of the given capacitor.
15. Write down Maxwell equation in integral form with their physical meanings. Convert these equations into differential form.
16. An electron is confined to an infinite height box of size 0.1 nm. Calculate the ground state energy of the electron. How this electron can be put to the third energy level?

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics (SH452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. A uniform circular disc of radius R oscillates in a vertical plane about a horizontal axis. Show that disc will oscillate with the minimum time period when the distance of the axis of rotation from the center is $\frac{R}{\sqrt{2}}$

OR

In the progressive wave show that the potential energy and kinetic energy of every particle will change with time but the average energy per unit volume remains constant.

2. A $2\mu\text{F}$ capacitor is charged up to 50 Volt. The battery is disconnected and 50mH is connected across the capacitor so that the LC oscillation occurs. Calculate the maximum value of the current in the circuit.
3. Show that the least possible distance between an object and its real image in a convex lens is four times the focal length of the lens.
4. What is path difference and phase difference in interference? Explain why we have to make a compensation in path difference in interference of light in parallel film in reflected system. Hence find out the condition for obtaining maxima in interference in this film by reflected light.

OR

What is Nicol Prism? How is it constructed? Discuss some of its applications.

5. A diffraction grating used at normal distance gives a green line $\lambda=5400\text{\AA}$ in a certain order superimposed on the violet line $\lambda=4500\text{\AA}$ of the next higher order. If the angle of diffraction is 10° , how many lines are there per centimeter in the grating?
6. What are Resolving Power and dispersive power of a diffraction grating? Show that the resolving power of a grating depends on the order and no of rulings of grating.
7. Calculate the reverberation time in a hall measuring $40 \times 10 \times 20$ ft with the following parameters. (i) 7500 sq.ft of plaster, $\alpha_1=0.03$ (ii) 400 sq.ft of glass, $\alpha_2=0.025$ (iii) 6000sq.ft.of wood and floor etc, $\alpha_3=0.06$ (iv) 600 seats $\alpha_4=0.03$ and (v) audience of 500 persons, $\alpha_5=4.0$ person.
8. What do you mean by Numerical Aperture and acceptance angle? Show that Numerical Aperture (NA) is proportional to square root of fractional refractive index change.

9. Derive an expression for the electric field intensity at any point in the axial line of a ring of charge q . From your result show that electric field is maximum at $x = \frac{a}{\sqrt{2}}$, where a is the radius of the ring.

OR

A capacitor of capacitance C is charged through a resistor obtains an expression for charging current. Show the variation of current with time. How will you use this information to calculate capacitance C .

10. What will be the force per unit area with which plates of parallel plate capacitor attract each other if they are separated by 1mm and maintained at 100 V potential difference and electric constant of the medium in unity.
11. Obtain Ohm's law in term of $\vec{J} = \sigma \vec{E}$, Explain why and how resistance of a conductor varies with temperature. Based on this information explain superconductor. Give at least two characteristics of superconductors.
12. Compare Ampere's law with Biot-Savart's law. Which is more useful for calculating B for a current carrying conductor. Calculate the magnetic field inside and outside a long straight wire carrying current I .

OR

State Faraday's law of Electromagnetic induction. Show that in electromagnetic induction the mechanical energy is converted into electric and finally in to heat energy.

13. A solenoid having an inductance of $6.3\mu\text{H}$ is connected in series with $1.2\text{K}\Omega$ resistor.
(i) If a 14V battery is connected across the pair, how long will it take for the current to reach 80% of its equilibrium value? (ii) What is the current through the resistor at time $t = \tau_L$
14. What is Hall effect? Obtain an expression for Hall resistance. Show in a graph how hall resistance varies with magnetic field.
15. Calculate the magnitude of the poyniting vector and the amplitude of the electric and magnetic fields at a distance of 10 cm from a radio station which is radiating power of 10^5 watt uniformly over a hemisphere with radio station as center.
16. Consider an electron of mass m is confined in an one dimensional infinite potential well of width l such that
 $V = \infty$ for $0 \leq x$ and $x \geq l$
 $V = 0$ for $0 < x < l$

Show that inside the well electron can only have the discrete energy values.

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics (SH402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What are drawbacks of simple pendulum? Show that the period of torsion oscillations remain unaffected even if the amplitude be large, provided that the elastic limit of the suspension wire is not exceeded.

OR

In simple harmonic motion, when the displacement is one-half the amplitude, what fraction of the total energy is kinetic energy and what fraction is potential energy? At what displacement is half kinetic energy and half potential energy?

2. Derive a differential equation of LC oscillation. With the solution of this equation, show that the maximum value of electric and magnetic energies stored in LC circuits is equal.
3. How much acoustic power enters the window of area 1.58m^2 , through the sound wave (standard intensity level 10^{-16}W/cm^2)? The window opens on a street where the street noise results in an intensity level at the window of 60dB.
4. Explain circle of least confusion. Show that the diameter of a circle of least confusion is independent of the focal length of a lens.
5. A glass clad fibre is made with core glass of refractive index 1.5 and cladding is doped to give a fractional index difference of 0.005. Find (i) the cladding index (ii) The critical internal reflection angle (iii) The external critical acceptance angle (iv) Numerical aperture (v) Acceptance angle.
6. A parallel beam of light ($\lambda=5890\text{\AA}$) is incident on a thin glass plate ($\mu = 1.5$) such that the angle of refraction is 60° . Calculate the smallest thickness of the plate which will appear dark by reflection.
7. How are Newton's Rings formed? How is the ring diameter and film thickness related? How can Newton's rings experiment be used to determine refractive index of a liquid?

OR

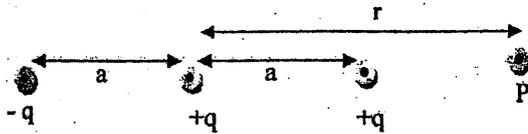
What is double refraction? How can we experimentally distinguish between plane polarized, circularly polarized and elliptically polarized light?

8. Assume that the limits of the visible spectrum are arbitrary chosen as 430nm and 680nm. Calculate the no. of rulings per millimeter of a grating that will spread the first-order spectrum through an angle of 20°
9. Define an electric dipole. How does a dipole behave in electric field? Obtain the conditions for maximum torque and maximum potential energy in an electric field.

OR

For the charge configuration of the figure, show that $V(r)$ at a point P on the line

assuming $r \gg a$ is given by $V = \frac{1}{4\pi\epsilon_0} \left(\frac{q}{r} + \frac{2qa}{r^2} \right)$.



10. A long cylindrical conductor has length 1m and is surrounded by a co-axial cylindrical conducting shell with inner radius double that of long cylindrical conductor. Calculate the capacitance for this capacitor assuming that there is vacuum in space between cylinders.
11. Charges of uniform volume density $3.2\mu\text{C}/\text{m}^3$ fill a non conducting solid sphere of radius 5cm. What is the magnitude of the electric field at (a) 3.5cm (b) 8cm from the centre of the sphere?
12. What are superconductors? How they differ from perfect conductors? Give basic properties and uses of superconductors.
13. Derive the relation for rise and fall of current in LR circuit. Plot a graph between current and time and explain the graph.

OR

In a Hall-effect experiment, a current of 3A sent length wise through a conductor 1 cm wide, 4cm long and $10\mu\text{m}$ thick produces a transverse (across the width) Hall potential differences of $10\mu\text{V}$, when a magnetic field of 1.5T is passes perpendicularly through the thickness of conductor. From these data, find: (a) The drift velocity of the charge carrier and (b) The number density of charge carrier.

14. A particular cyclotron is designed with dees of radius $R = 75\text{cm}$ and with magnets that can provide a field of 1.5T. (i) To what frequency should be oscillator be set if deuterons are to be accelerated? (ii) What is the maximum energy of deuterons that can be obtained? Given mass of the deuteron is $3.34 \times 10^{-27}\text{kg}$.
15. Define Poynting vector. Prove that $\vec{S} = \frac{1}{\mu_0} (\vec{E} \times \vec{B})$.
16. Prove that the energy levels are quantized, when the electron is confined in an infinite potential well of width a.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What is forced oscillation? Derive differential equation for forced oscillation and show that amplitude at resonance is inversely proportional to damping constant of medium.

OR

Derive the differential equation for damped LCR oscillation. Obtain an expression for current and frequency of oscillation.

2. Prove that if a transverse wave is traveling along a stretched string, the slope at any point of the string is numerically equal to the ratio of the particle speed to the wave speed at that point.
3. The volume of a room is 600m^3 , wall area of room is 220m^2 , the floor and ceiling area each is 120m^2 . If average absorption coefficient for walls is 0.03, for ceiling is 0.80 and for floor is 0.06, calculate average absorption coefficient and reverberation time.
4. Two thin lenses of power P_1 and P_2 are separated by a distance d . Find an expression to show that equivalent power of the combination is given as $P = P_1 + P_2 - dP_1P_2$.
5. Explain the formation of Newton's ring in reflected light. Prove that, in reflected light the diameter of the dark rings are proportional to the square root of natural numbers and diameter of bright rings are proportional to the square root of odd numbers.

OR

Write down the physical meanings of dispersive power and resolving power of plane transmission grating. Show that both resolving and dispersive power have proportional relation with the order of spectrum.

6. A 200mm long tube containing 48cm^3 of sugar solution produces an optical rotation of 11° when placed in a polarimeter. If specific rotation of sugar solution is 66° , calculate quantity of sugar contained in the form of solution.
7. Light is incident normally on a grating 0.5cm wide with 2500 lines. Find the angles of diffraction for the principal maxima of the two sodium lines in the first order spectrum, $\lambda_1 = 5890\text{\AA}$ and $\lambda_2 = 5896\text{\AA}$. Are the two lines resolved?
8. What is principle of laser? Discuss how population inversion is carried out? With the help of energy level diagram, explain how He-Ne laser works.

9. A thin non conducting rod of finite length l carries a total charge q spread uniformly along it. Show that the electric field at any point at a distance y above from the centre of

rod is $E = \frac{q}{4\pi\epsilon_0 y} \frac{1}{\sqrt{l^2 + 4y^2}}$. Extend this result for infinite length.

OR

Find the potential at any point at an angle θ at a distance r from the centre of the short dipole. What result do you obtain if the point is along axial line?

10. A capacitor is made of two concentric spherical plates of radii a and b of inner and outer spheres respectively. If outer plate is positively charged and inner sphere is earthed, prove

that the capacitance of such capacitor is given as, $C = 4\pi\epsilon_0 \left[\frac{b^2}{b-a} \right]$.

11. Calculate the relaxation time for the electrons of sodium atom. The number of atoms per cm^3 in sodium is 2.5×10^{22} , and the electrical conductivity is 1.9×10^7 s/m.
12. List and explain methods to calculate magnetic field due to a current carrying conductor. Derive an expression for the magnetic field on the axial line of a long solenoid carrying current.

OR

What is self inductance? Calculate the inductance of a circular Toroid. From your result, show that inductance is a property of a coil and depends on permeability and shape and size of the coil.

13. Suppose a cyclotron is operated at an oscillator frequency of 12MHz and has a dee of radius 53cm.
- What is the magnitude of the magnetic field needed for deuteron to be accelerated in the cyclotron?
 - What is the resulting kinetic energy of the deuteron? Given: mass of deuteron = 3.34×10^{-27} kg.
14. What must be the magnitude of a uniform electric field if it is to have the same energy density that passed by a 0.50T magnetic field?
15. What is poynting vector? Show that the intensity of an electromagnetic wave equals the average magnetic energy density times the speed of light.
16. A particle is moving in one dimensional potential well of infinite height and width a . find the expression for energy of the particle.

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What is a torsional pendulum? Obtain an expression for its time period and explain why, unlike a simple or a compound pendulum the time period in this case remains unaffected even if the amplitude be large?

OR

Derive the differential equation of the forced oscillation of LCR circuit with ac source and find the expression for the current amplitude.

2. A meter stick suspended from one end swings as a physical pendulum (a) what is the period of oscillation (b) what would be the length of the simple pendulum that would have the same period.
3. Calculate the minimum intensity of audibility in watts per square cm from a note of 1000 Hz if the amplitude of vibration is 10^{-9} cm. Given density of air is 0.0013 gm/cc and velocity of sound in air is 340 m/s.
4. What is diffraction of light? Discuss the intensity distribution with special reference to diffraction of light in a single slit.

OR

Define circle of least confusion and show that $d = \frac{1}{2} WD$,

Where

d = diameter of circle of least confusion

W = dispersive power

D = diameter of lens aperture

5. A plano-convex lens of radius 300cm is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of the 8th dark ring in the transmitted system is 0.72cm. Calculate the wavelength of light used.
6. What is double refraction? Using the concept of double refraction show that the plane polarized and circularly polarized light are the special cases of elliptically polarized light.
7. Two similar thin convex lenses of focal length 10cm each are placed co-axially 5cm apart. Find the equivalent focal length and the position of principal points. Also find the position of the object for which the image is formed at infinity.
8. What is an optical fibre? Discuss its types. Derive the relation for Numerical Aperture (NA) in an optical fibre.

9. Find the electric field at a distance x above the centre of the flat circular disc of radius R which carries a uniform surface charge density σ . Extend your result in the limit $R \rightarrow \infty$.

OR

Show that the electric field due to a short dipole at a point on the axial line is twice as that of a point on the equatorial line.

10. Differentiate between polar and non-polar dielectrics. Using Gauss's law in dielectrics establish relation of electric field with displacement vector and polarization vector. Hence obtain the relation for free and induced charge in the dielectric.
11. What is the average time between collisions of free electrons in a copper wire? (At. wt. = 63 g/mol, density = 9 gm/cc and resistivity = $1.7 \times 10^{-8} \Omega\text{m}$, $N_A = 6.02 \times 10^{23} \text{mol}^{-1}$)
12. A spherical drop of water carrying a charge of $3 \mu\text{C}$ has a potential of 500V at its surface. What is the radius of drop? If two such drops of same charge and radius are combined, what is potential of the single new drop formed?
13. A variable field of 10^{12}V/m.s is applied to a parallel plate capacitor with circular plates of diameter 10cm. Calculate (a) induced magnetic field and (b) displacement current.
14. A circular coil having radius R carries a current I . Calculate the magnetic flux density at an axial distance x from the centre of the coil. Explain how the coil behaves for a large distance point and at what condition field will be maximum?

OR

Show that the energy per unit volume in electric field and magnetic field are proportional to the square of their fields.

15. Derive the Schrodinger time independent wave equation. What is the physical significance of wave functions?
16. Using Maxwell equations in free space, derive electromagnetic wave equations for \vec{E} and \vec{B} . Write its plane wave solution.

Exam.	New Back (2066 Batch Only)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

Attempted

1. Derive a relation for the time period of a compound pendulum and compare it with that of simple pendulum to locate the centre of oscillation.

OR

Obtain differential equation for forced oscillation. Write its solution. Explain the statement "quality factor (Q) is a measure of the sharpness of resonance in the case of a driven oscillator".

2. Derive a relation for speed of transverse wave in a stretched string and show that the average rate of energy transfer is $\frac{1}{2} \rho \omega^2 A^2 v$, Where the symbols are having usual meanings.
3. Write down the requirements for a good acoustic hall and derive a relation for reverberation time.
4. Explain chromatic aberration. Show that the longitudinal chromatic aberration is equal to the product of dispersive power and mean focal length of a lens.

OR

Define the term "optical activity". Derive a relation for the specific rotation of any optically active substance. Also write down its applications.

5. A glass clad fiber is made with the core glass of refractive index 1.5 and the cladding is doped to give a fractional index change of 0.0005. Determine
 - a) the cladding index,
 - b) the acceptance angle and
 - c) the numerical aperture.
6. Newton's rings are observed in reflected light of wavelength 5900Å. The diameter of 10th dark ring is 50mm. Find the radius of curvature of lens and thickness of air film.
7. In a grating the sodium doublet (5890Å, 5896Å) is viewed in third order at 30° to the normal and is resolved. Determine the grating element and the total width of the rulings.
8. Calculate the thickness of (i) a quarter wave plate and (ii) a half wave plate given that $\mu_E = 1.553$, $\mu_O = 1.544$ and $\lambda = 5 \times 10^{-5}$ cm.
9. What is electric Quadrapole? Finding an expression for electric potential at any point on an axial line at a distance 'r' from centre of short Quadrapole, show that electric field at that point is inversely proportional to r^3 .

OR $\frac{q}{4\pi\epsilon_0 r^3} = 9 \times 10^9 \cdot (2a^2)$

A ring of radius 'R' is carrying a uniformly distributed charge 'q'. Find an expression for electric field at any point on the axial line. Locate the point at which electric field is maximum.

10. A parallel plate capacitor each of area 100cm^2 has a p.d. of 50V and capacitance of $100 \times 10^{-6} \mu\text{F}$. If a mica of dielectric constant 5 is inserted between plates find the magnitude of
- a) Electric field in mica
 - b) Displacement vector
 - c) Polarization vector
11. Compare the methods of Biot Savart law and Ampere's law to calculate magnetic fields due to current carrying conductor. Calculate magnetic field at an axial distance 'r' from the centre of the circular coil carrying current.
12. A current of $1.2 \times 10^{-10}\text{A}$ exists in a copper wire (At. wt. = 63 and density = 9gm/cc) whose diameter is 2.5mm . Assuming current to be uniform, calculate:
- a) Current density
 - b) Electrical conductivity
 - c) Mobility of electrons
13. What is cyclotron? Find an expression to show that maximum kinetic energy of charge particles coming out of dees of cyclotron is directly proportional to square of frequency of oscillator

OR

What is Hall-effect? Derive an expression for Hall coefficient and establish the relation with mobility of charge carrier and conductivity of material of wire.

14. A proton with speed of $3 \times 10^5 \text{m/s}$ orbits just outside a charged sphere of radius 1cm . What is the charge on the sphere?
15. Write Maxwell equations in integral form. Convert them in differential form. Explain each equations.
16. A free particle is confined in a box of width L . Find an expression for energy eigen value to show that the particle can have only discrete energy and momentum.

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32 -
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Six questions selecting One each from Group A & D and Two each from Group B & C.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) Define physical pendulum. Show that the radius of gyration is equal to distance from centre of suspension to centre of gravity of a compound pendulum, when time period is minimum. [1+5]
- b) A solid sphere of mass $5/2$ kg and diameter $2/7$ m is suspended on a thin metallic wire. Find the period of angular oscillation if the torque constant of the wire is 6×10^{-3} Nm/rad. [4]
- c) What are particle velocity and wave velocity? Find the relation between them. [3]
2. a) Differentiate between reverberation and echo. Derive a relation for the reverberation time with reference to acoustically fit hall. [6]
- b) A mass of 6 kg stretches a spring 0.3m from its equilibrium position. The mass is removed and another body of mass 1.0 kg is hanged from the spring. What would be the period of oscillation if the spring is now stretched and released? [3]
- c) The relaxation time for a damped harmonic oscillator is 50 seconds. Determine the time in which the amplitude and energy of oscillator falls to $1/e$ times of its initial value. [4]

Group B

3. a) What are coherent sources of light? Why it is essential to generate coherent sources to observe the interference? Show that there is zero energy at dark fringes of interference phenomena. [1+1+3]
- b) Differentiate between curvature of field and distortion. Also draw neat and clean diagram of such aberrations. [2.5+2.5]
- c) In a plane transmission grating the angle of diffraction for second order maxima for wavelength 5×10^{-5} cm is 30° . Calculate the number of lines in one cm of the grating surface. [4]
4. a) Explain the phenomenon of double refraction in uniaxial crystal. What are quarter wave and half wave plates? [6]
- ✓ b) Discuss the propagation mechanisms of light waves in optical fiber. [4]
- c) Distance between two slits is 0.1mm and the width of the fringes formed on the screen is 5mm. If the distance between the screen and the slit is one meter, what would be the wavelength of light used? [4]

5. a) Discuss the essential requirements for producing laser action. Describe a Ne-Ne laser. [5]
 b) Two thin convex lenses having focal lengths 6cm and 2cm are co-axial and separated by a distance of 4cm. Calculate the combined focal length and the positions of the principal planes. [5]
 c) A 20cm long tube containing sugar solution rotates the plane of polarization by 11° . If the specific rotation of sugar is 66° , calculate the strength of the solution. [4]

Group C

6. a) Define dielectric strength. Derive a relation for the capacitance of a spherical capacitor consisting of two concentric spherical shell of radii y and z , (with $z > y$). [1+5]
 b) If a copper wire is stretched to make it 2.5% longer than its original length, what is the percentage change in resistance? [4]
 c) List industrial uses and hazard of high intensity electrostatic field. Explain in detail, one of the uses. [3]
7. a) Explain resistivity. Obtain the expression for resistivity in terms of mean free path. [5]
 b) State Biot-Savarts law. Use it to determine the magnetic field of a narrow circular coil along its axis. [5]
 c) The current in a LR circuit builds up to one third of its steady state value in 5 sec. What is the inductive time constant? [3]
8. a) State the Ampere's circuital law. Derive the relation for the self induction of a toroid. [5]
 b) Two particles of equal charges of $2.0 \times 10^{-7}C$ but opposite signs are held 15cm apart. what are the magnitudes and directions of \vec{E} at a point midway between them? [4]
 c) A copper strip 2cm wide and 1mm thick is placed in a magnetic field with $B = 1.5T$. If a current of 200A is setup in the strip, what Hall p.d. appears across the strip? (Given: $n = 8.4 \times 10^{28}$ per m^3) [4]

Group D

9. a) What is displacement current? Also write its significance. [3]
 b) Derive a differential equation for LC oscillation with initial charge Q_0 . Derive an expression for the frequency of the oscillation, then relate it with spring-mass system. [6]
 c) A 10 Henry coil has a resistance of 180Ω What size of capacitor must be put in series with it if the combination is to resonant when connected to 60 Hz outlet? [4]
10. a) With the help of Maxwell's equations prove the relation $C = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$, where symbols carry their usual meanings. [4]
 b) Prove the continuity relation $\vec{\nabla} \cdot \vec{J} + \frac{\partial \rho}{\partial t} = 0$. [4]
 c) The maximum electric field at a distance of 20m from an isotropic point light source is 4.0 v/m. Calculate (i) the maximum value of the magnetic field and (ii) the average intensity of light there. [5]

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Six questions selecting One each from Group A & D and Two each from Group B & C.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

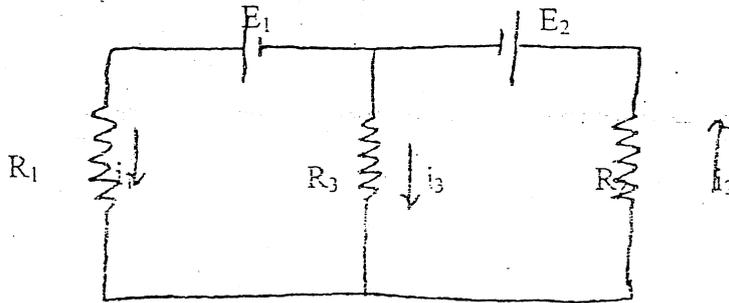
1. a) What is torsional pendulum? Show that motion of a disc of a torsional pendulum is harmonic. Find its time period. Describe how will you determine modulus of rigidity of a thin metallic wire which supports the disc. [7]
- b) The amplitude of a lightly damped oscillator decreases by 3% during each cycle. What fraction of the energy of the oscillator is lost in each full oscillation? [3]
- c) A source of sound has a frequency 2.56 Hz and amplitude of 0.25cm. Calculate the flow of energy across a square centimeter in one second if the velocity of sound in air is 340 m/s and the density of air is 0.00129 gm/cc. [3]
2. a) What is reverberation? Derive the reverberation time and explain how it depends on absorption coefficient of the medium. Discuss the significance of this formula with reference to the acoustics of a building. [7]
- b) Derive an expression for velocity of a wave in a stretched string. [3]
- c) Two sounds differ in sound level by 1.00 dB. What is the ratio of the greater intensity to the smaller intensity? [3]

Group B

3. a) What is an optical fiber? Explain the physics behind its functioning. Trace the ray diagram that shows the propagation of light through the step index and graded index optical fibres. [7]
- b) Define cardinal points and locate these points within the lens. [3]
- c) A dielectric slab of thickness 'b' is inserted between the plates of a parallel-plate capacitor of plate separation 'd'. Show that the capacitance is then given by
$$C = \frac{K \epsilon_0 A}{Kd - b(K - 1)}$$
, where the symbols have their usual meanings. [4]
4. a) Explain the phenomenon of interference of light. Give the theory of the Newton's ring. How fringes can be used to find the wavelength of light. [6]
- b) Light is incident normally on a grating of total ruled width 5×10^{-3} m with 2500 lines in a cell. Find the angular separation of the sodium lines in the first order spectrum. Wavelengths of lines are 589nm and 589.6nm. Can they be seen distinctly? [4]
- c) What is astigmatism? What is the cause of it and how can it be reduced to a minimum? [4]
5. a) Write down the physical meanings of dispersive power and resolving power of plane transmission grating. Show that both resolving and dispersive power have proportional relation with the order of the spectrum. [7]
- b) A quarter-wave plate is 12.5 μ m thick. Calculate the wavelength for which it acts as a quarter wave plate. The difference in the principal refractive indices is 0.01. [3]
- c) Find the specific rotation of a given sample of sugar solution if the plane of polarization is turned through 26.4°. The length of the tube containing 20% sugar solution is 20cm. [4]

Group C

6. a) A thin ring made of plastic of radius R is uniformly charged with linear charge density λ . Calculate the electric field at any point at an axial distance Y from the center. If electron is constrained to be in axial line of the same ring, show that motion of electron is simple harmonic. Find frequency of oscillation. Mention any assumptions you made. [7]
- b) In the given figure, find the currents i_1, i_2, i_3 if $E_1 = 1.5V, E_2 = 3V, R_1 = R_3 = 2\Omega$ and $R_2 = 4\Omega$. [3]



- c) A copper strip 2cm wide and 1mm thick is placed in a magnetic field with $B = 1.5 T$ perpendicular to the plane of the strip and away from the reader. If a current of 200A is set up in the strip, what Hall potential difference appears across the strip? Charge density of copper = $8.4 \times 10^{28}/m^3$ [3]
7. a) Define electric dipole. Find an expression for electric potential at any point in space due to dipole of length $2a$. Could you extend this relation to calculate electric field intensity? If so, how? [5]
- b) What is the drift velocity of a copper wire having diameter 0.25cm carrying current of 10A? Given density of copper = $9 gm/cm^3$; and molar mass of the copper is 64 gm/mole. [4]
- c) What is the magnetic energy density at the centre of the circulating electron in the hydrogen atom? Assume that the electron circulates around the nucleus in a path of radius $5.1 \times 10^{-11} m$ at a frequency of $6.8 \times 10^{15} rev/sec$. [4]
8. a) Differentiate between Biot-Savart law and Ampere's law in calculating magnetic field of a current carrying conductor. Calculate the magnetic field on the axial line of a long straight solenoid carrying current. [7]
- b) A capacitor of capacitance C is charged through the resistor R . Calculate the time at which the potential across the resistor is equal to the potential across the capacitor. [4]
- c) Calculate the capacitance of the earth, viewed as a spherical conductor of radius 6400km. [3]

Group D

9. a) What is electromagnetic oscillation? Derive a differential equation for free em oscillation. Find the time period of oscillation. How frequency will be changed if there is resistance in the circuit? [7]
- b) Why and how Maxwell modified Ampere's law in magnetism? [3]
- c) Calculate the magnitudes of electric and magnetic field vectors associated with e-m waves emitted from a source 35 km away if its power of emission is 30 kW. [3]
10. a) Write Maxwell's equation in integral form and the laws in which these equations are based. Convert them into differential form. [6]
- b) Derive electromagnetic wave equations in free space. Give their plane wave solution. Based on these solutions prove that $\frac{E}{B} = C$. [4]
- c) In an LC circuit, what value of charge, expressed in terms of the maximum charge, is present on the capacitor when the energy is shared equally between the electric and magnetic field? [3]

Exam.	Regular/Back		
	Level	B/E	Full Marks
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Six questions selecting at least One from Group A & D and Two from Group B & C.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

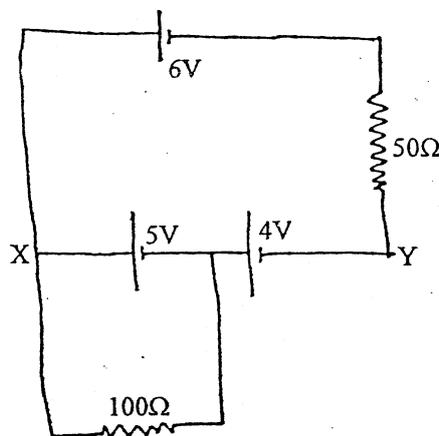
1. a) What is a compound pendulum? Deduce the expression for the time period of a compound pendulum and formulate the equivalent length of the simple pendulum. [1+6]
- b) Calculate the change in intensity level when the intensity of sound increases 100 times the original intensity. [3]
- c) A line source emits a cylindrical expanding wave. Assuming the medium absorbs no energy, find how the amplitude and intensity of the wave depend on the distance from the source. [3]
2. a) Explain the term "wave motion". Show that for a plane progressive wave, on the average, half the energy is kinetic and half potential. [1+5]
- b) A lecture hall with a volume of 4500m^3 is found to have a reverberation time of 1.5 sec. What is the total absorbing power of all the surfaces in the hall? If the area of the sound absorbing surface is 1600m^2 , calculate the average absorption coefficient. [3]
- c) A string 2.72m long has a mass of 263 gm. The tension in the string is 36.1N. What must be the frequency of travelling waves of amplitude 7.7mm in order that the average transmitted power be 85.5W? [4]

Group B

3. a) What are cardinal points of an optical system? Determine the equivalent focal length of a combination of two thin lenses separated by a finite distance. Hence find the position of two principal points. [1+5+2]
- b) What is an optical fiber? How is it made? Write down the main differences between step index and graded index multimode optical fibers. [3]
- c) Calculate the thickness of (i) a quarter wave plate and (ii) a half wave plate, given that $\mu_E = 1.553$, $\mu_0 = 1.544$ and $\lambda = 5890\text{\AA}$ [3]
4. a) What are monochromatic aberrations? Explain the term spherical aberration and astigmatism and their minimization with suitable ray diagrams. [1+7]
- b) Newton's rings are formed by reflected light of wavelength 5895\AA with a liquid between the plane and curved surfaces. If the diameter of the 6th bright ring is 3mm and the radius of curved surface is 100cm, calculate the refractive index of the liquid. [4]
- c) Distinguish between Fraunhofer and Fresnel diffraction. [2]
5. a) What is population inversion? Explain why laser action cannot occur without population inversion between atomic levels? [1+4]
- b) Explain circle of least confusion. Show that diameter of circle of least confusion is dependent of the focal length of a lens. [5]
- c) Two thin lenses of focal lengths f_1 and f_2 separated by a distance d have an equivalent focal length 50cm. The combination satisfies the conditions for no chromatic aberration and minimum spherical aberration. Assuming both the lenses are made of same material, find the values of f_1 , f_2 and d . [4]

Group C

6. a) State general form of Gauss law. Calculate potential difference between two plates of a charged cylindrical capacitor. [5]
- b) In the given circuit diagram, find the current in each resistor and potential difference between X and Y. [4]



- c) A strip of copper $150\mu\text{m}$ wide is placed in a uniform magnetic field \vec{B} of magnitude 0.65T , with \vec{B} perpendicular to strip. A current 23A is then sent through the strip such that a Hall potential difference V appears across the width of the strip. Calculate V . Given number of charge carriers per volume for copper is 8.47×10^{28} electron/ m^3 . [4]
7. a) What is dipole? Derive an expression for electric field due to dipole at the points on the (i) axis of the dipole and (ii) perpendicular bisector of dipole. [1+3+3]
- b) Show that the time constant in RC circuit is the time at which the charge in the circuit will reach a value $\frac{1}{e}$ of its final equilibrium value. [3]
- c) Two long parallel wires are 8.1cm apart. What amount of equal and antiparallel current flow in the wires if the magnetic field halfway between them is $296\mu\text{T}$? [3]
8. a) State and explain Faraday laws of induction. Deduce the expression for the inductance of a toroid. [1+4]
- b) State Biot-Savart law. Use it to find magnetic field at any point due to long straight current carrying conductor. [1+3]
- c) What will be the force per unit area with which plates of parallel plate capacitor attract each other if they are separated by 1mm and maintained at 100V potential difference and electric constant of the medium is unity. [4]

Group D

9. a) Explain what are Maxwell's equations. Write Maxwell's equations in free space and find the electromagnetic equations for electric and magnetic field. Also provide their plane wave solutions. [7]
- b) What is displacement current? Why Maxwell's modification is necessary is Ampere's law in magnetism? [3]
- c) You are given an inductor of 1mH . If you are asked to make it oscillate with a frequency of 1MHz , how can you make such an oscillating device? [3]
10. a) What are free and damped electromagnetic oscillations? Deduce the frequency of a damped electromagnetic oscillation and hence show the charge distribution with time graphically. [7]
- b) The maximum electric field at a distance 10m from an isotropic point light source is 2V/m . (i) What is the average intensity of light there (ii) What is the power of the source? [4]
- c) Show that the displacement current in a parallel plate capacitor is given by $C \frac{dv}{dt}$. [2]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agric.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Six questions selecting at least One from Group A and D and Two from Group B and C.
- ✓ All questions carry equal marks.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) Differentiate between free oscillation and forced oscillation. [3]
- b) What is torsional pendulum? Find the time period for torsion pendulum. Also write its significance. [5]
- c) A spring is hung vertically and loaded with a mass of 75 grams and allowed to oscillate, calculate (i) the time period and (ii) the frequency of oscillation, when the spring is loaded with 100 grams it extends by 5cm. [5]
2. a) What are the differences between interference and beats? [3]
- b) Define absorption coefficient? Derive Sabine's reverberation formula and also explain its importance in our daily life? [6]
- c) A police man on duty detects a drop of 12 percent in the pitch of a motor car as it crosses him. If the velocity of sound is 332 m/s, calculate the speed of the car. [4]

Group B

3. a) Calculate the equivalent focal length of two thin co-axial lenses separated by a finite distance x . Also derive expressions giving the positions of the two principal points. [4+2]
- b) Write down the properties of LASER. Also explain the terms optical pumping, population inversion and stimulated emission. Write the merit and demerit of laser. [1+3+1]
- c) In Newton's rings experiment the radius of the 4th and 12th rings are 0.26cm and 0.37cm respectively. Find the diameter of the 24th dark ring. [3]
4. a) What are the conditions for coherent sources? Explain the phenomenon of interference in thin film for reflected light. [1+5]
- b) What is optical fibre? Explain the graded index multimode optical fibre and also write the application of optical fibre in communication system as well as medical science. [4]
- c) What is the highest order spectrum, which may be seen with monochromatic light of wavelength 559nm, by means of a diffraction grating with 15000 lines/inch? [4]
5. a) State and explain the theory and resolving power of a plane transmission grating. [5]
- b) What do you mean by plane polarized light? Explain the phenomenon of double refraction in crystal. [1+4]

- c) Calculate the polarizing angle for light travelling from water of refractive index 1.34 to glass of refractive index 1.52. [4]

Group C

6. a) Define the term electric dipole. Calculate the potential at a point along the axis of the quadrupole. [1+4]
 b) Explain the principle of parallel plate capacitor and determine its capacitance. [4]
 c) If a copper wire is compressed to make 0.5 percent shorter. What is the percentage change in resistance? [4]
7. a) Define the terms conductance and resistivity. Explain the atomic view of Ohm's law. Also write down the limitations of Ohm's law. [6]
 b) What is difference between intrinsic and extrinsic semiconductor. Derive the relation conductivity of semiconductor. [3]
 c) Two small spheres of charge 14 micro coulomb and 35 micro coulomb placed 20cm apart. Find the location of a point between them where the field strength is zero. [4]
8. a) What is magnetic flux density? Derive an expression for magnetic flux density inside a long solenoid, carrying current I, at a point near its center. [1+4]
 b) Prove that magnetic energy density is directly proportional to the square of the magnetic flux density. [4]
 c) A copper strip 2cm wide and 1.5mm thick is placed in a magnetic field with magnetic strength 2.6 Tesla. If a current of 145A is set up in the strip, what Hall potential difference appears across the strip? The number of charges is 8.4×10^{28} per meter cube. [4]

Group D

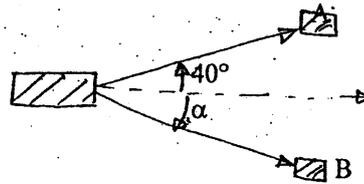
9. a) What is meant by LC oscillation? Derive the differential equation of an LC circuit also calculate the frequency of LC oscillation.
 b) Derive the Maxwell's equations in differential form also explain their physical significance.
 c) Using Maxwell's equation prove that $(E/B) = C$. [3]
10. a) Define poynting vector and show that $S = (1/\mu_0)E \times B$ where symbols carry their usual meanings. [5]
 b) What is displacement current? Prove that the displacement current density in a parallel capacitor can be written as $\vec{J}_d = \epsilon_0 \frac{d\vec{E}}{dt}$. [3]
 c) What should be the capacitance of a capacitor in a tuned circuit of frequency 10 MHz having an inductance of 0.01 mH? The resistance of the circuit is negligible. [4]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

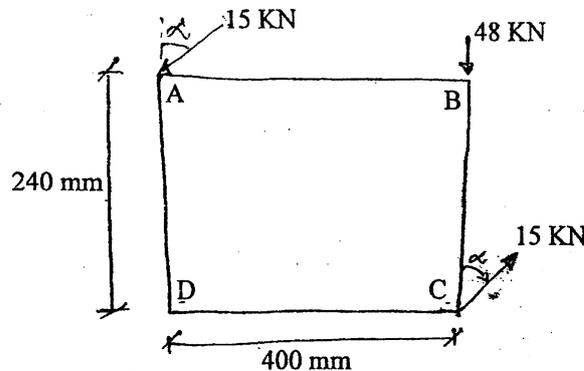
Subject: - Applied Mechanics (CE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

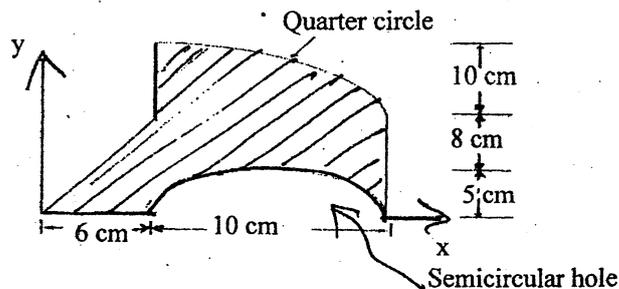
- How does deformable bodies differ from rigid body? What were the assumptions made regarding rigid body for our present study? [3+3]
- A vehicle needs 50 kN to be moved forward by two pullers A and B. Puller A is at 40° to the axis of movement. Compute the value of angle ' α ' for which puller B has to exert minimum force. Also compute the respective values of pull to be exerted. [3+3]



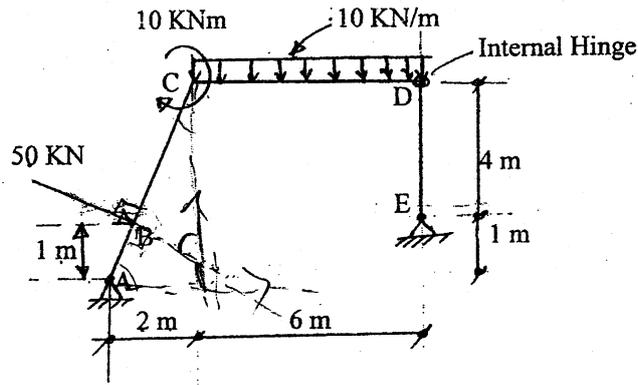
- A rectangular plate is acted upon by the force and couple shown in figure below. The system is to be replaced by a single equivalent force. [11]



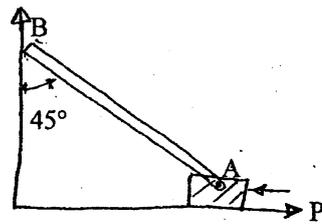
- For $\alpha = 40^\circ$, specify the magnitude and the line of action of the equivalent force
 - Specify the value of α , if the line of action of the equivalent force is to intersect line CD 300 mm to the right of D.
- State and prove the parallel axis theorem for moment of inertia. Find the moments of inertia about the axes through centroid of given shaded area. [4+8]



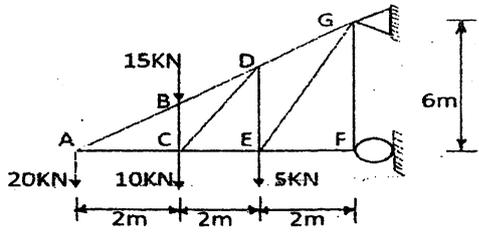
5. Calculate and draw the axial force, shear force and bending moment diagram; with its salient features for the given plane frame. [13]



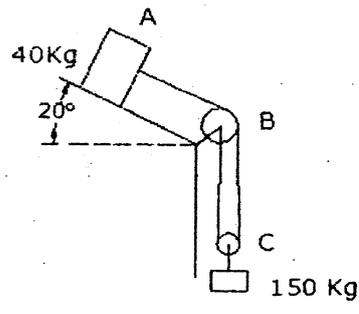
6. A uniform bar AB having length 5 m and weighing 500 N is fastened by a frictionless pin to a block, weighing 200 N as shown in figure below. At the vertical wall, co-efficient of friction is 0.3 while under the block is 0.20. Determine the force P needed to start the motion to the left. [4]



7. Determine the force developed in members BD, CD, EG and DE of given truss. [8]



8. The acceleration of a particle is given by the relation $a = 21 - 12x^2$, where a is expressed in m/s^2 and x is in meters. The particle starts with no initial velocity at origin. Determine: [10]
- The velocity when $x = 1.5$ m
 - The position where velocity is again zero
 - The position where velocity is maximum
9. a) Define dynamic equilibrium and impulse momentum principle for particle. [2]
- b) Two blocks in figure are start from rest. The pulleys are frictionless and having no mass. The kinetic coefficient of Friction between the blocks 'A' and the inclined plane is 0.4. Determine the acceleration of each block and tension in each chord. [8]

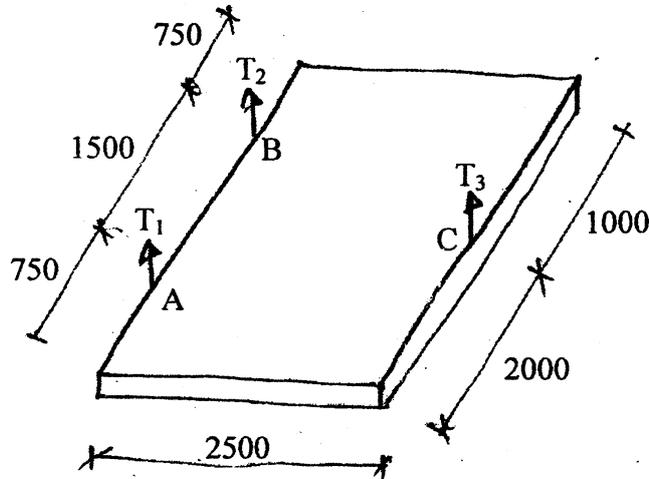


Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

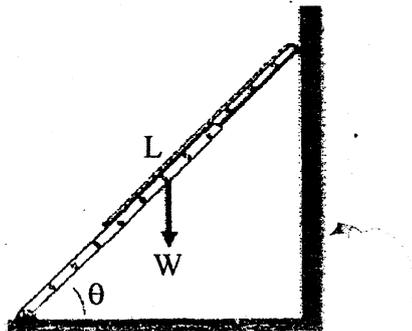
Subject: - Applied Mechanics (CE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

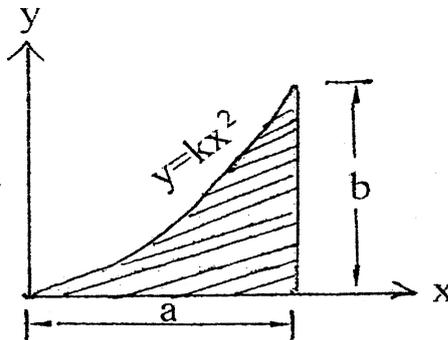
1. What is mechanics? Mention scope of Applied Mechanics in engineering.
2. Illustrate equilibrium condition of a rigid body and concept of free body diagram with suitable examples.
3. Three vertical wires as shown in figure support a plate of 50 kg. Determine the tension in each wire. All dimensions are in mm.



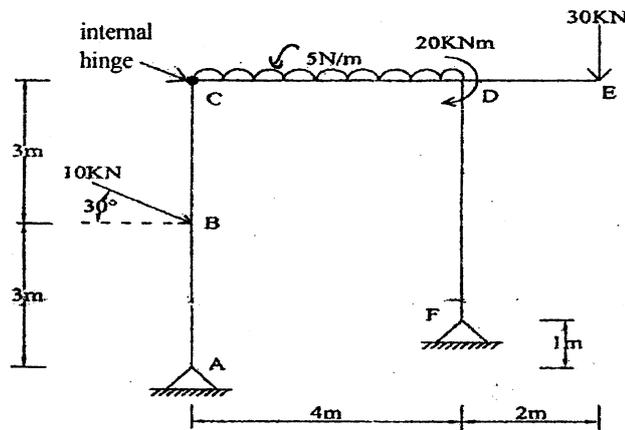
4. Force $\vec{F} = (3\hat{i} - 6\hat{j} + 4\hat{k})\text{N}$ passes through point (6, 3, 2) m. Replace this force with an equivalent system, where the force \vec{F} passes through point (2, 5, 10) m.
5. Determine the minimum angle θ (made by the ladder AB of length 'L' with the floor) at which a uniform ladder can be placed against a wall without slipping under its own weight (W). The coefficient of friction for all surfaces is 0.2.



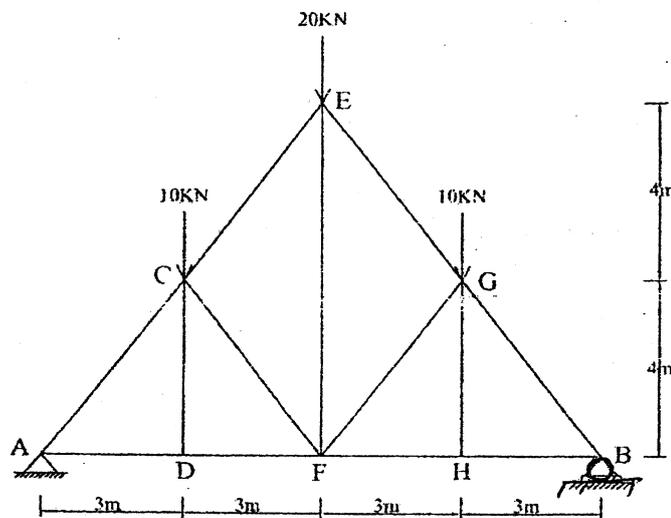
6. Determine the moment of inertia about centroidal axis of the shaded plane area by using Direct integration method. [12]



7. Draw the axial force, shear force and bending moment diagram of given frame. Indicate also the salient features if any. [14]

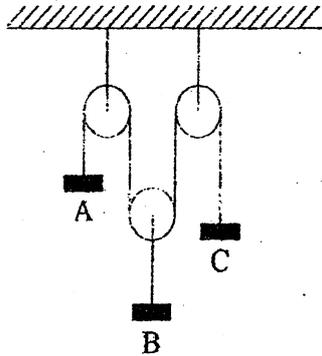


8. Determine the force developed in members CE, DF, EF, GH of given truss loaded as shown in figure. [8]



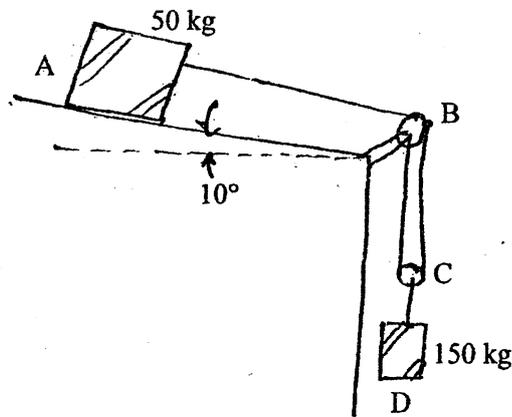
9. Define uniformly rectilinear motion and uniformly accelerated rectilinear motion. For the pulleys systems as shown in figure, calculate the velocity and acceleration of Block 'C'. If the velocities and acceleration of Block 'A' and 'B' are $3 \text{ m/s}(\downarrow)$, $2 \text{ m/s}^2(\uparrow)$, $4 \text{ m/s}(\uparrow)$ and $5 \text{ m/s}^2(\downarrow)$ respectively.

[8]



10. Two blocks shown in figure starts from rest. The pulleys are frictionless and having no mass. The kinetic co-efficient of friction between block A and inclined plane is 0.37. Determine the acceleration of each block and tension in each cord. What do you mean by dynamic equilibrium?

[8+2]



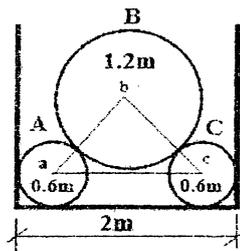


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

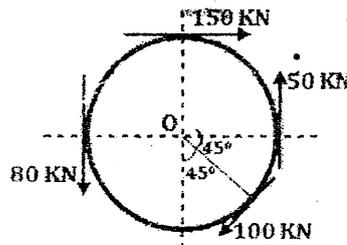
Subject: - Applied Mechanics (CE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

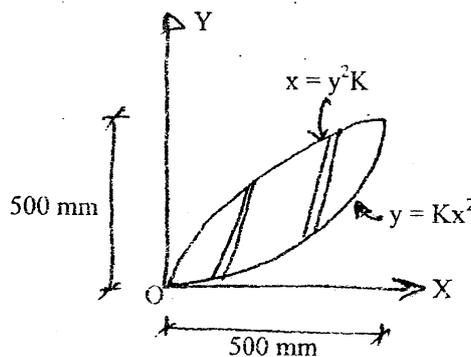
1. a) Describe the scope of applied mechanics. [3]
- b) The cylinders A and C weight 1000 N each and the weight of cylinder B is 2000 N. Determine the forces exerted at the contact points. [7]



2. a) What is Free Body Diagram and why it is used during analysis of structure? [4]
- b) Determine the resultant of the forces acting tangentially to a circle of radius 3 m as shown in figure. What will be the location of the resultant with respect to centre of the circle? [8]



3. Explain the laws of static friction. Also define the limiting friction and angle of friction with suitable example. [2+1+1]
4. Determine the centroid of the hatched area by Direct Integration Method. State and prove the parallel axis theorem for moment of inertia. [8+4]

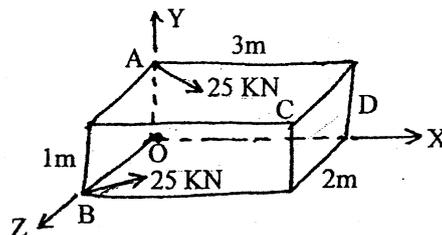


Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

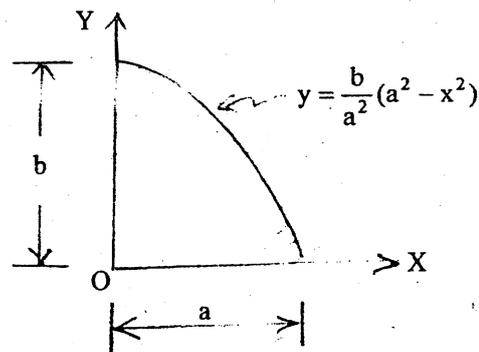
Subject: - Applied Mechanics (CE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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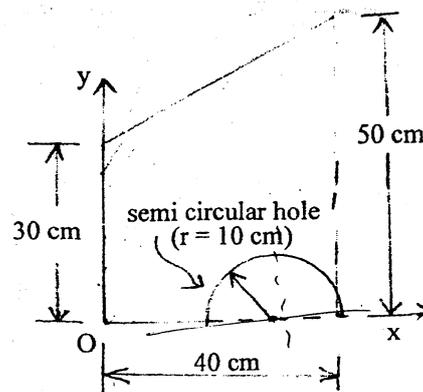
1. What do you mean by rigid body? Why it is necessary to assume a body as "perfectly rigid" for the study of statics. [1+2]
2. What is free body diagram? Why is it necessary to draw free body diagram in solving any structural problems? Also describe equation of equilibrium in two dimension. [2+3+3]
3. If two forces of same magnitude 25 kN act at points A and B as shown in figure and force at A passes through C and force at B passes through D. (a) Find equivalent force-couple system at 'O' [12]
 (b) Find equivalent wrench and give pitch and axis of wrench.



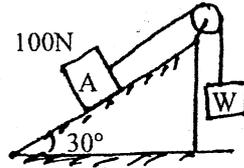
4. Locate the centroid of the area bounded by the curve as shown in figure, by the method of integration. [6]



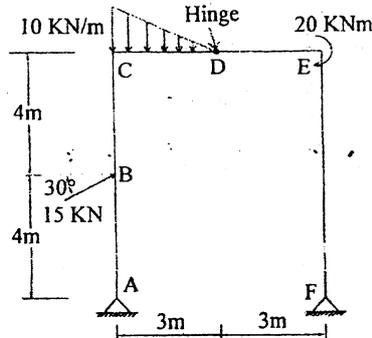
5. Calculate the moment of inertia of the composite area as shown in figure, about x-axis. [6]



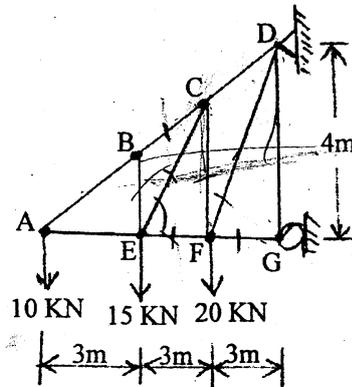
6. A block 'A' of weight 100 N rests on an inclined plane and another weight w is attached to the first weight through a string as shown in figure. If the coefficient of friction between the block and plane is 0.3, determine the maximum value of W so that equilibrium can exist. [5]



7. Draw axial force, shear force, bending moment diagram for the loaded frame shown in figure. Indicate also the salient features if any. [12]

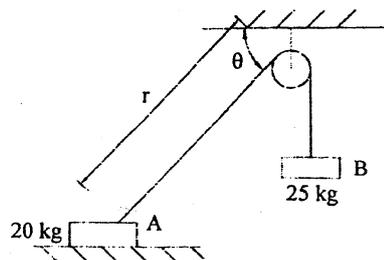


8. Calculate the force developed in members BC, EC, EF, FC, FD and FG of the cantilever truss loaded as shown in figure. [8]



9. Deduce the relationship of radial and transverse components of velocity and acceleration for a particle moving along the curve path. The acceleration of a particle is defined by the relation, $a = kt^2$, knowing that velocity is -32 m/sec when time is zero second and again velocity is $+32$ m/sec when time is 4 sec. (a) Determine, the value of the constant K , (b) Write the equations of motion knowing also that position of the particle is zero at the instant of 4 sec. [4+6]

10. The velocity of block 'A' is 2 m/s to the right at the instant when $r = 0.8$ and $\theta = 30^\circ$. Neglecting the mass of pulleys, and the effect of friction in the pulley, and between block 'A' and the horizontal surfaces. Determine at this instant (a) the tension in the cable (b) the acceleration of the block A (c) the acceleration of the block B. [10]

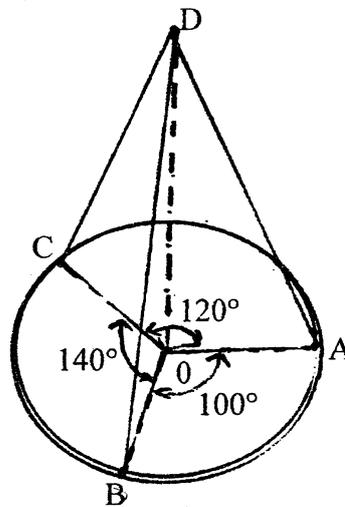


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

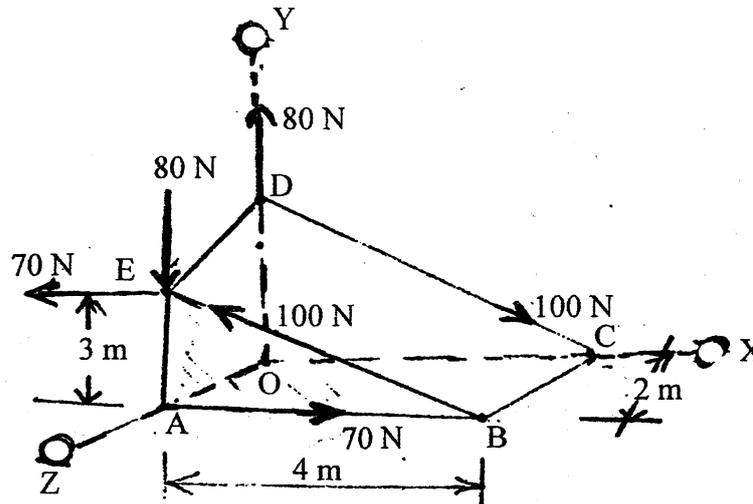
Subject: - Applied Mechanics (CE451)

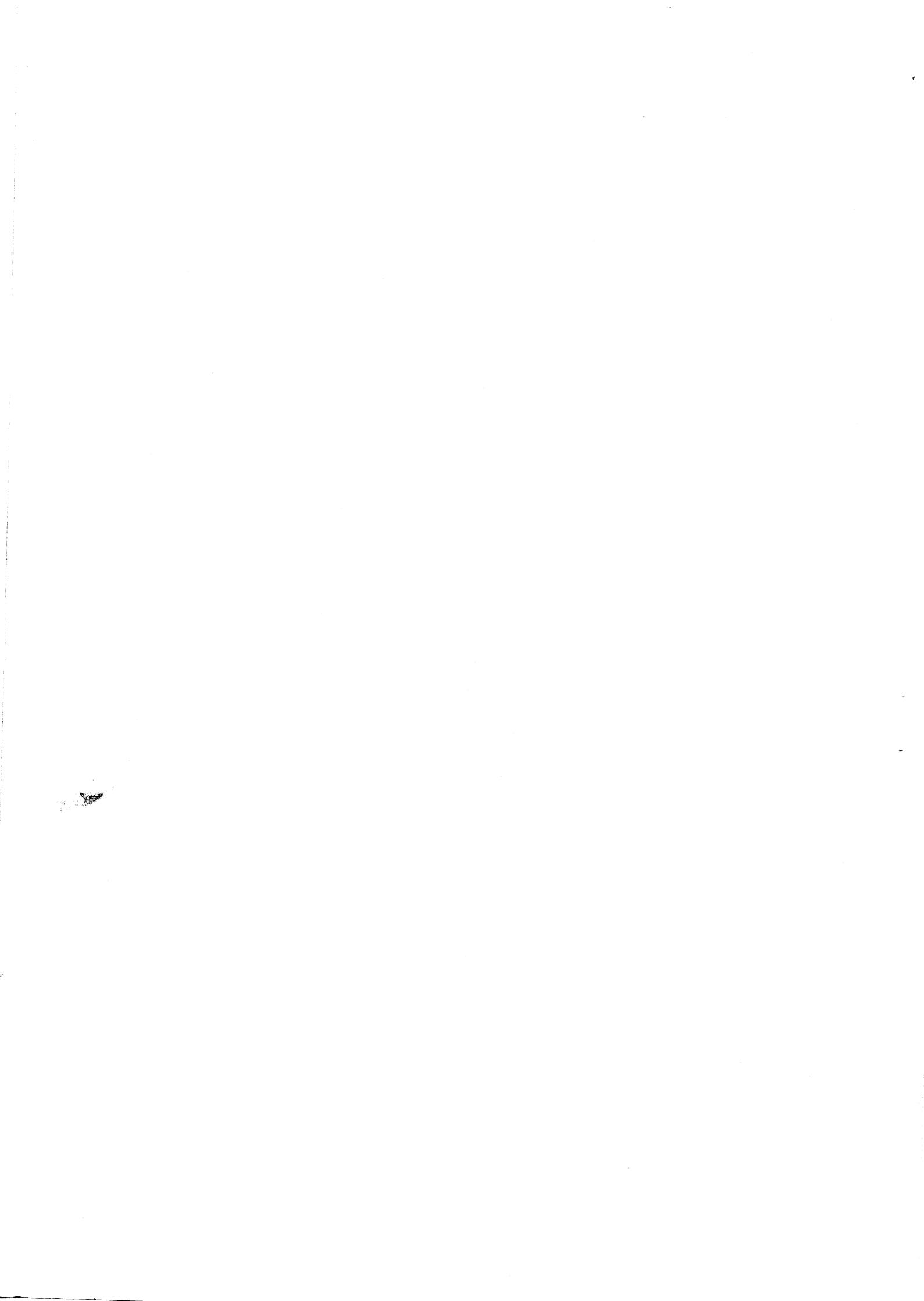
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. Differentiate between rigid body and deformable body. [3]
2. Explain about the physical meaning of equilibrium. Define free body diagram and concept of particle. [3+2+2]
3. A homogeneous circular plate of mass 50 kg is supported by three wires. The angular distance between the points of attachment on the circumference of the plate w.r.t center of the plate makes an angle of 100° while other two angular distances are 120° and 140° as shown in figure below. The three wires are attached to a single point on the ceiling which is 5 m vertically above the centroid of the plate. The plate has diameter of 1 m. Calculate the force developed in each wires. [8]



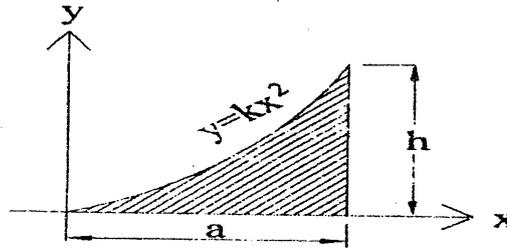
4. Three pairs of couples are acted on the triangular block as shown in figure below. Determine the resultant of them. [4]





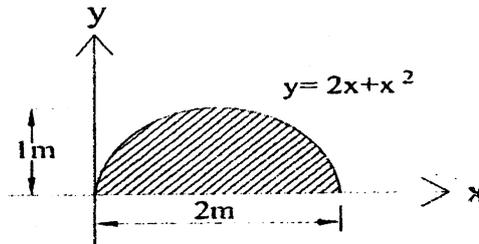
5. Determine the centroidal X and Y coordinate of the shaded area.

[6]



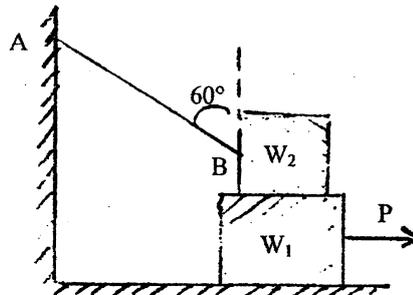
6. Determine the moment of inertia area about X-axis.

[5]



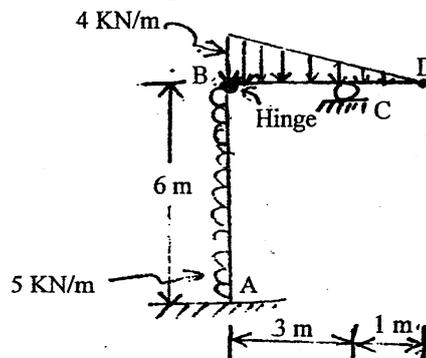
7. A block of weight $W_1 = 1800 \text{ N}$ rests on a horizontal surface and supports on the top of it another block of weight $W_2 = 1000 \text{ N}$ as shown in figure below. The block W_2 is attached to a vertical wall by the inclined string AB. find the magnitude of the horizontal force P, applied to the lower block as shown, that will be necessary to cause sliding to impend. The coefficient of static friction for all contact surfaces is 0.4.

[6]



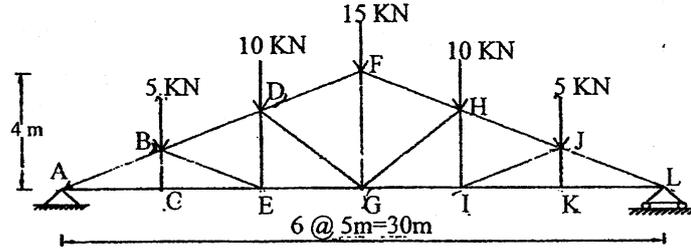
8. Deduce the relationship between load, shear force and bending moment for a beam section loaded uniformly with intensity of load W. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any.

[4+9]



6]

9. Determine the member forces in member CE, FH, GH, GI of given truss. [8]



[5]

10. Two ships A and B are at a distance of 4800 m apart B being south east of A. Speed of A is 2.6 m/s due east and B is travelling at speed of 4.47 m/s due north. Determine: (a) The relative velocity of B w.r.t A (b) The shortest distance between them (c) Time taken to reach the shortest distance. [10]

11. What do you mean by principle of impulse and momentum? The resultant external force acting on a 30 N particle in space is, $\vec{F} = (12t\hat{i} - 24t^2\hat{j} + 30t^3\hat{k})$ N, where t is the time measured in seconds. Initially, particle is at origin and at rest. Determine Y-component of acceleration, velocity and position at the instant of 5 sec. [3+7]

[6]

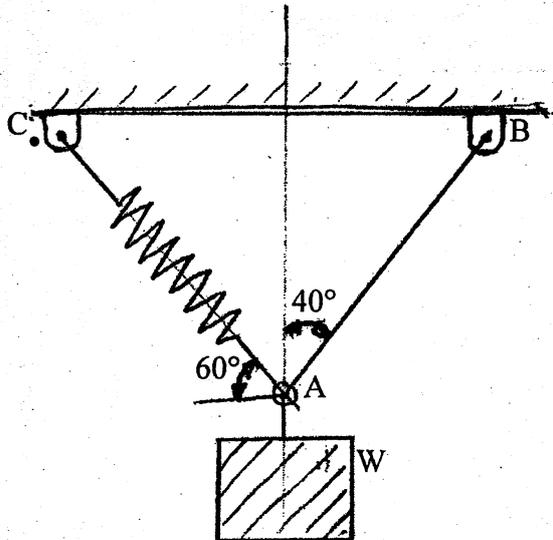
[4+9]

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

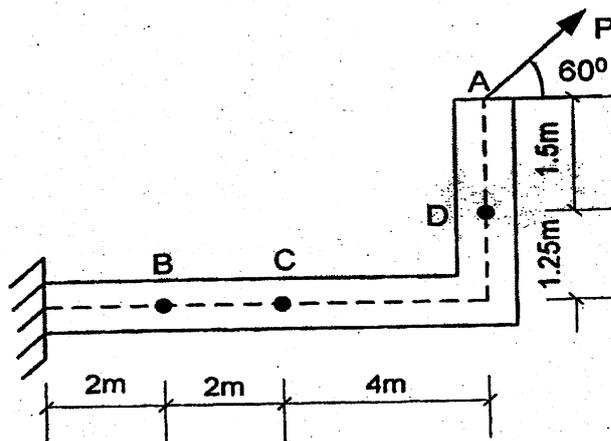
Subject: - Applied Mechanics (CE 401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

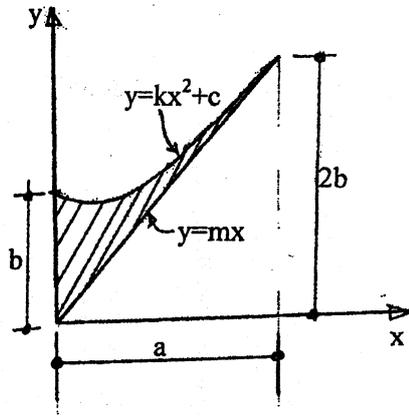
1. Differentiate between rigid body and deformable body. [3]
2. A container of weight W is subjected from ring A to which cable AB and spring AC are attached. The constant of spring is 100N/m and its unstretched length is 3m . Determine the tension in the cable; when (a) $W = 120\text{N}$ (b) $W = 160\text{N}$. [8]



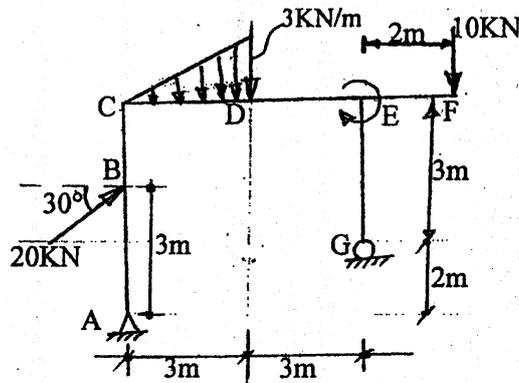
3. A 160N force P is applied at point A of a structural member. Replace P with (a) An equivalent force-couple system at C , (b) and equivalent system consisting of a vertical force at B and a second force at D . [12]



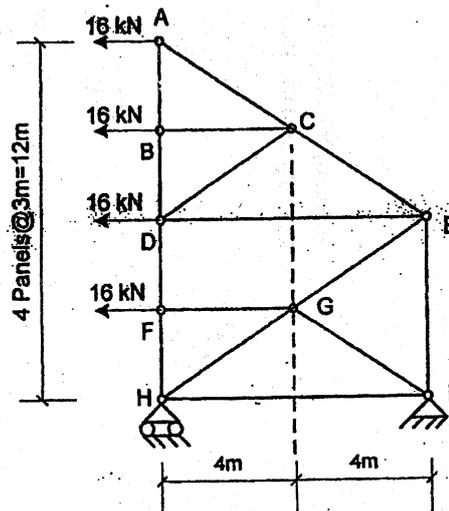
4. Determine the polar moment of inertia and the polar radius of gyration of the shaded area as shown in figure below with respect to centroid. [12]



5. Define static friction. Explain why coefficient of static friction is always less than that of kinetic friction coefficient. Support your answer with relevant equations. [1+3]
6. Calculate and draw the axial force, Shear force and bending moment diagram with its salient features; for the given frame as shown in figure below. [13]



7. Use method of section to determine member forces DE, DF and GI for the given pin jointed truss and also indicate the nature of forces. [8]

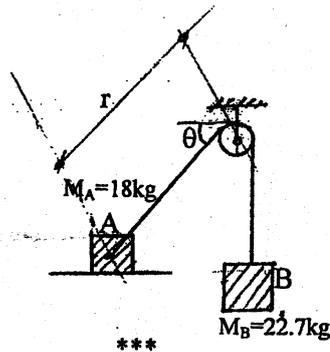


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8. A particle moving in a straight line has an acceleration, $a = \sqrt{v}$, its displacement and velocity at time $t = 2$ sec, are $\frac{128}{3}$ m and 16m/s. Find the displacement velocity and acceleration at time $t = 3$ sec. [10]
9. The two blocks as shown in figure below are released from rest when $r = 0.73$ m and $\theta = 30^\circ$. Neglecting the mass of the pulley and the effect of the friction in the pulley and between block A and the horizontal surface. Determine:

- a) The initial tension in the cable
 b) Acceleration of the block 'A' and 'B'

[10]



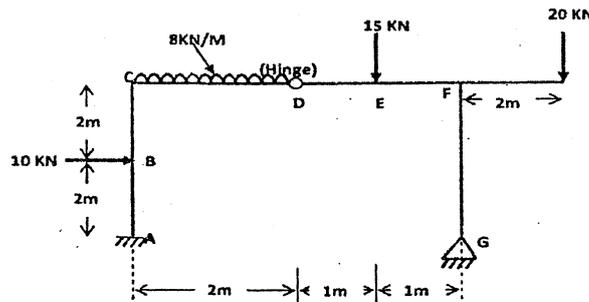
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Applied Mechanics

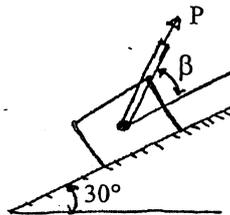
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define the fundamental principles on which the study of mechanics rests. [3]

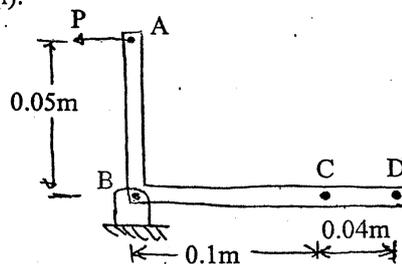
b) Draw the axial force, shear force and bending moment diagram of the given frame. Also show the salient features. [13]



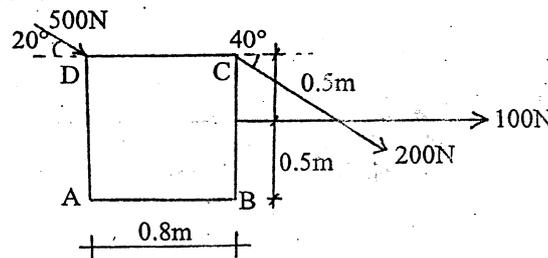
2. a) Knowing that the coeff. of friction between 25 kg block and the incline is $\mu_s = 0.25$. Determine (i) smallest value of P required. to start the block moving up the incline (ii) corresponding value of β . [4]



b) The 80N horizontal force P act on a bell crank as shown in figure below. (i) Replace P with an equivalent force-couple system. (ii) Find two vertical forces at C and D that are equivalent to the couple formed in (i). [2+3]

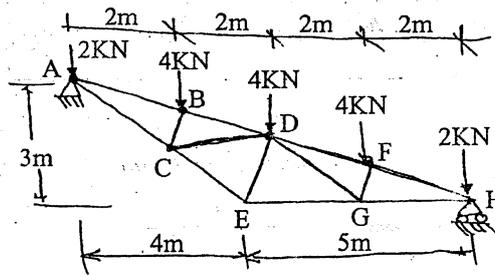


c) Determine magnitude, direction and position of the resultant of forces acting on a block as shown in figure below. [7]

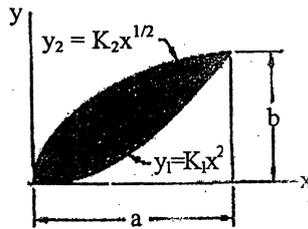


3. a) What is static equilibrium? What are the equations of static equilibrium in two dimension? Describe briefly the importance of them. [2+3+3]

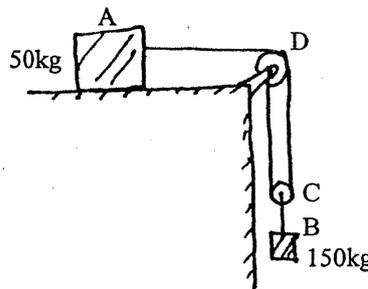
- b) Determine the force in members DE, CD and AB for the inverted Howe Roof truss. State whether each member is in tension or compression. [8]



4. a) Determine the centroid of following enclosed (hatched) area with the curves $y_1 = K_1x^2$ and $y_2 = K_2x^{1/2}$, and also given that the extreme values of along X-axis and Y-axis are 'a' and 'b' respectively. Use direct integration method. [6]

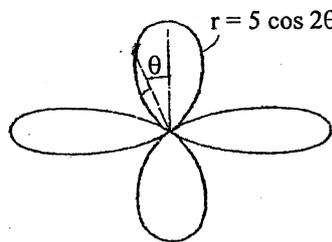


- b) The two blocks shown in figure below start from rest. The horizontal plane and the pulley are frictionless and the mass of pulley is negligible. Determine the acceleration of each block and the tension in each cord. [10]

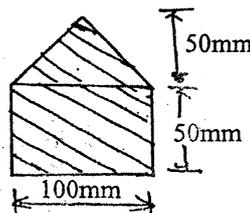


OR

- b) The particle, having the position vector of $r = 5 \cos(2\theta)m$, is travelled in a curvilinear path as shown in figure below, where $\theta = 3t^2(\text{rad/s})$. Find the velocity and acceleration of the motion of the particle at $\theta = 30^\circ$. [10]



5. a) Determine moment of inertia about the centroidal x-axis of the shaded area shown in figure below. [6]



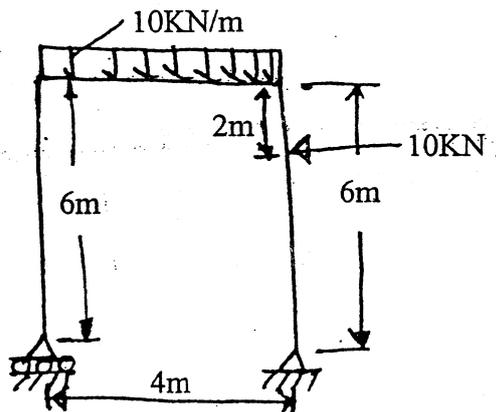
- b) A projectile is fired from the edge of a 250m cliff with an initial velocity of 360m/s at an angle of 45° with the horizontal. Neglecting air resistance, find (i) The greatest elevation above the ground reached by the projectile (ii) The horizontal distance from the gun to the point where the projectile strikes the ground. [10]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

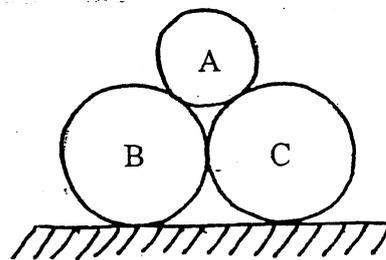
Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

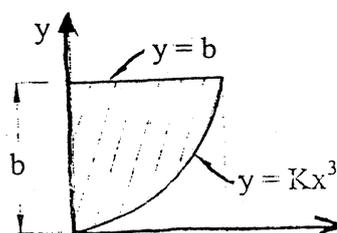
1. a) Write ^{the} principle of transmissibility and define couples with suitable examples. [4]
- b) Draw axial force, shear force and bending moment diagram for the frame shown in figure below. [12]



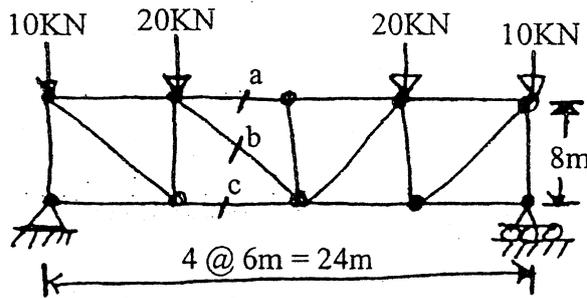
2. a) State and prove parallel axis-theorem for moment of inertia. [6]
- b) Find the contact forces of the three bodies as shown ⁱⁿ figure below. Body A has 20cm diameter and 60N weight and bodies B and C have 30cm diameter and 100N weight each. [10]



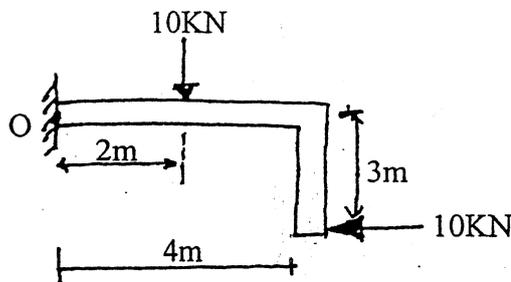
3. a) Define limiting friction, angle of friction and coefficient of static and dynamic friction. [6]
- b) Determine by direct integration the centroid of the shaded area as shown in figure below. [10]



4. a) Explain free body diagram with suitable examples. [6]
 b) Find bar forces in members a, b and c in ^{the} truss as indicated in figure below. Shown loads are vertical at the joints. [10]



5. a) Explain ^{the} relationship ^{between} among position, velocity and acceleration of a particle in rectilinear motion. [6]
 b) A ball is thrown vertically upward with a velocity of 25 m/sec. After 2 ^{second} sec another ball is thrown with the same velocity. Find the height at which the two ball pass each other. [10]
6. a) State Newton's second law of motion and derive ^{the} relation between linear momentum and force. [6]
 b) Resolve the force system as shown in figure below into equivalent force-couple system about O. ^{an} [10]



Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Applied Mechanics II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) "Graphical solutions are useful to simplify the problems related to dynamics". Justify this statement. [7]
- b) A nozzle discharges a stream of water in the direction as shown in fig-1 with an initial velocity of 30 m/sec. Determine the radius of curvature of the stream (i) as it leaves the nozzle, (ii) after 1.5 sec and (iii) at the maximum height of the stream. [9]

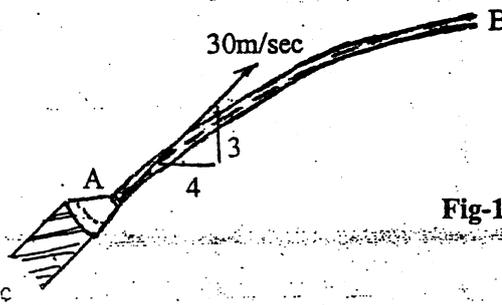


Fig-1

2. a) Obtain the expression for tangential and normal components of acceleration for a particle moving along a curve path. [7]
- b) A satellite is launched in a direction parallel to the surface of the earth with a velocity of 37,000 km/hr from an altitude of 500 km. Determine the altitude attained by it when it covers the angular distance equal to 15° . Also calculate the periodic time of the satellite. Take radius of earth, $R = 6,370$ km. [9]
3. a) Obtain the expression for trajectory of a particle moving under central force. [7]
- b) The magnitude and direction of the working of two identical smooth balls before they strike each other are as shown in fig-2. Assuming coefficient of restitution, $e = 0.90$, determine the magnitude and direction of the velocity of each ball after the impact. How much K.E. will be lost due to the impact? [9]

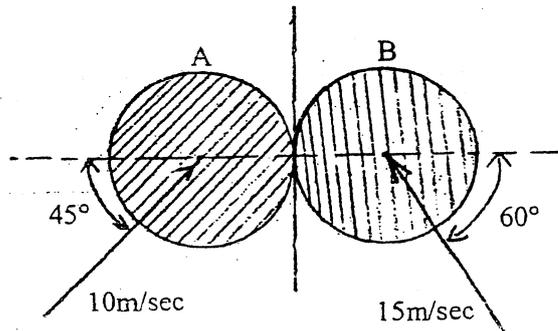


Fig-2

7. a) Obtain the expression for kinetic energy of system of particles while considering the centre of mass. [7]

b) A system of three masses is connected by massless rigid rods as shown in fig-3. If the three masses move 3m up the plane under the action of force \vec{F} , find the work done on the system. Assume $F = 1.36 \text{ KN}$, $w_1 = w_2 = 2w_3 = 0.56 \text{ KN}$, $\mu_d = 0.1$ and that the maximum frictional force is developed between each mass and the surface. [9]

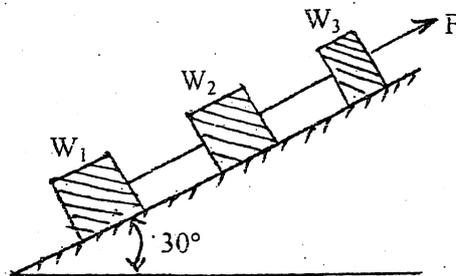


Fig-3

5. a) Explain what is general plane motion of a rigid body? Illustrate it suitable examples. [7]

b) The centre of the double gear has velocity of 2.4 m/sec and an acceleration of 6 m/sec^2 to the right as shown in fig-4. Recalling that lower rack is stationary, determine (i) the angular acceleration of the gear, (ii) the acceleration of points B, C and D of the gear. [9]

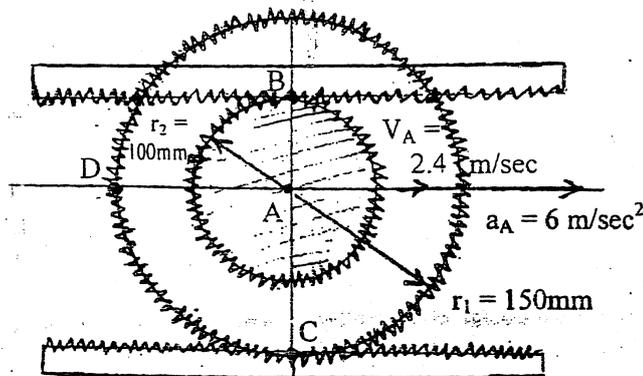


Fig-4

6. a) Explain what is free vibration of a rigid body? How the effective length of vibrating plate can be obtained while dealing with the free vibration of a rigid body? [7]

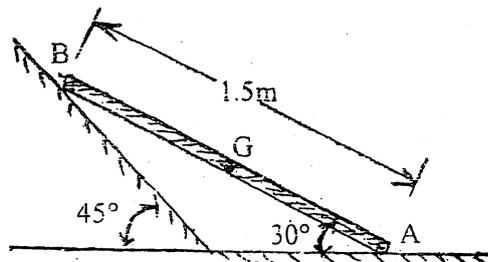


Fig-5

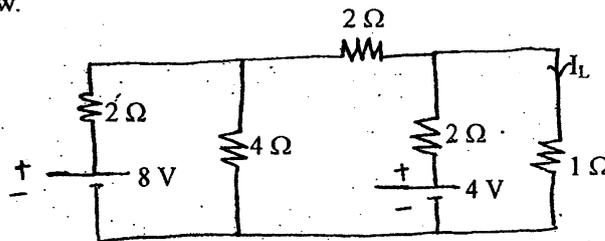
b) The extremities of a 1.5m rod of mass 30 kg moves freely with no friction along two straight tracks as shown in fig-5. If the rod is released with no initial velocity from the position shown, determine the angular acceleration of the rod. [9]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

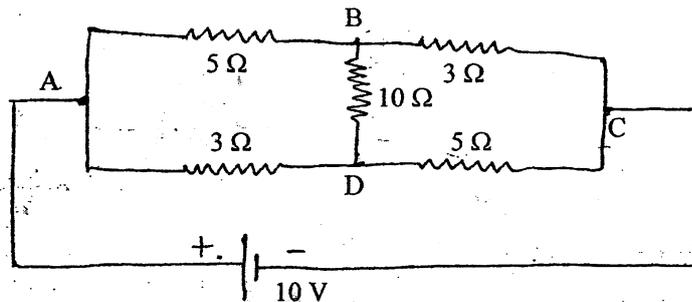
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

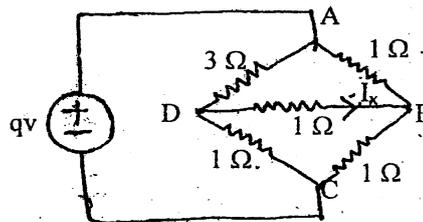
1. a) At room temperature of 20°C, the current flowing at the instant of switching of a 40W filament lamp with 220V supply is 2A. The filament material has a resistance temperature coefficient of 0.005/°C at 20°C. Calculate the working temperature of filament and current taken by it during normal working condition. [6]
- b) Derive the formula $I = n.A.e.V$ where the symbols used have their usual meaning. [5]
- c) Apply KVL and KCL to determine current I_L through 1Ω resistor in the network shown below. [5]



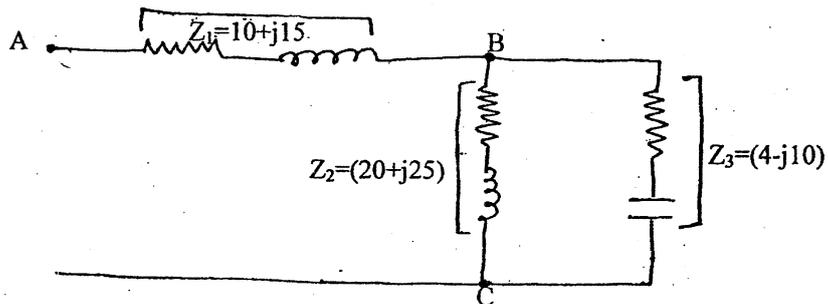
2. a) Define maximum power transfer theorem and derive the condition for maximum power transfer across the load resistance. [8]
- b) Find the current in the branch BD of the circuit given below by using Thevenin's. [8]



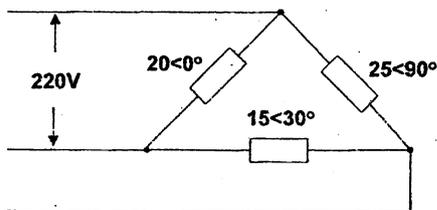
3. a) Derive the equation for instantaneous current flowing through a pure inductor when excited by an ac sinusoidal voltage $v = v_m \sin \omega t$. Draw the wave form of voltage and current and also show analytically and graphically that it does not consume real power. [8]
- b) Find the value of I_x in the circuit shown below by the method of nodal analysis. [8]



4. a) What do you understand by dynamically and statically induced emfs? Hence define self and mutually induced emf and magnetic coupling between two coils. [4]
- b) Derive an expression for the equivalent inductance of two inductors when they are connected in series (i) adding combination (ii) Opposing combination [6]
- c) A $10\ \Omega$ resistor is connected in series with a $100\ \mu\text{F}$ capacitor to a $230\ \text{V}$, $50\ \text{Hz}$ supply. Find (i) The impedance (ii) Current (iii) Power factor (iv) Phase angle (v) Voltage across the resistor and the capacitor. [6]
5. a) Three elements, a resistance of $100\ \Omega$, an inductance of $0.1\ \text{H}$ and a capacitance of $150\ \mu\text{F}$ are connected in parallel to a $230\ \text{V}$, $50\ \text{Hz}$ supply. Calculate the : (i) Current in each element (ii) Supply current (iii) Phase angle between the supply voltage and the supply current with the help of a phasor diagram. [6]
- b) In the circuit shown in figure below, determine the equivalent impedance that appears across the terminals AC. [4]



- c) For the 3-phase delta connected circuit below. Determine the line currents and total active, reactive and apparent power. [6]



Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define ideal current source. Show that if α_1 is the resistance temperature coefficient of a conductor at temperature t_1 °C then resistance temperature coefficient at t_2 °C is

$$\text{given by } \frac{\alpha_1}{1 + \alpha_1(t_2 - t_1)}$$

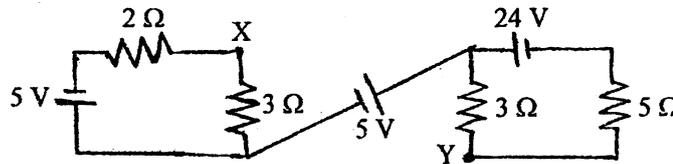
[5]

- b) A coil has a resistance of 18Ω when its mean temperature is 20°C and of 20Ω when its mean temperature is 50°C . Find its mean temperature rise when its resistance is 21Ω and the ambient temperature is 15°C .

[5]

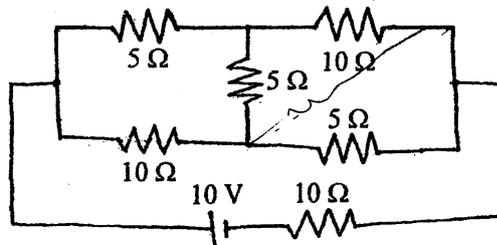
- c) Find V_{XY} in the figure.

[5]



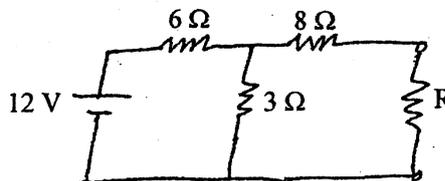
2. a) Find equivalent resistance of the given network.

[5]



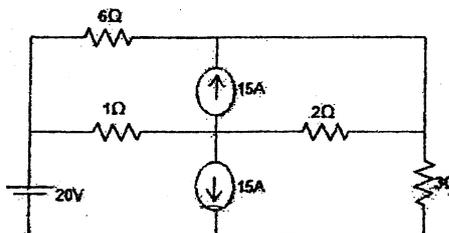
- b) Determine the value of R for maximum power to R and calculate the power delivered under this condition.

[4]

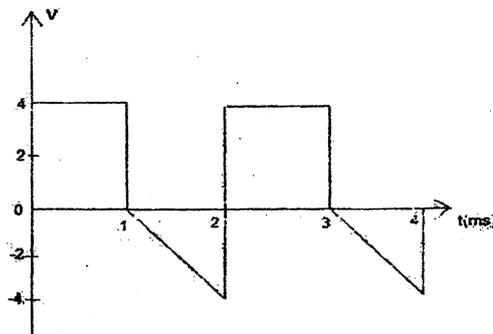


- c) Calculate the voltage drop across 3Ω resistor using Superposition Theorem in the circuit given below.

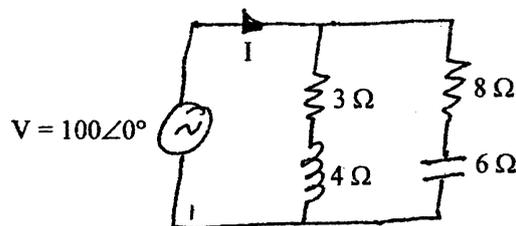
[6]



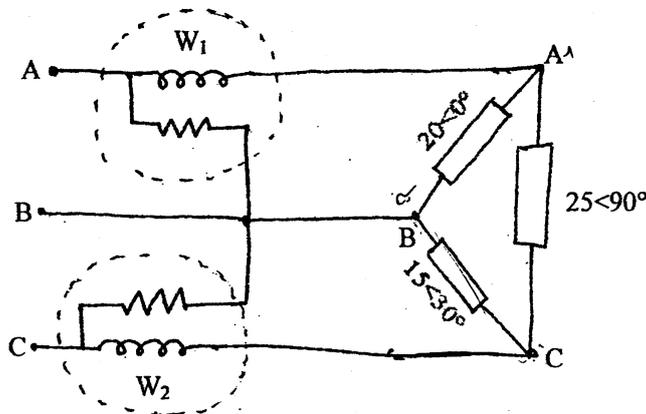
3. a) Explain super node and needs with suitable example. [4]
 b) Define capacitance and inductance. Also classify the capacitors on the basis of geometrical shapes. [4]
 c) Calculate the Rms value and Average value of the voltage wave given below and hence compute the form factor. [8]



4. a) Explain the operation of purely capacitive circuit excited by a sinusoidal source and hence prove that average power consumed by such circuit is zero. Draw necessary waveforms. [6]
 b) For the circuit given below, calculate the current I. Draw the phasor diagram of the circuit. [6]



5. a) The supply system is 230 V, 3-phase, 50 Hz. Determine the readings of wattmeters W_1 and W_2 . Phase sequence is AB-BC-CA. [7]



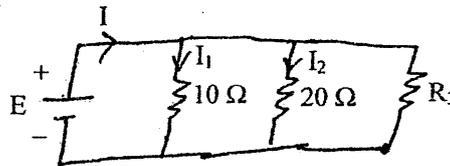
5. a) Derive the equation for the instantaneous current when A.C. voltage is supplied to a series R-L circuit. Draw phasor diagrams and analyze power in the circuit. [6]
 b) Calculate the amount of current through the neutral of a balanced 3-phase star connected circuit. Also verify with the phasor diagram. [3]
 c) An electric circuit is being supplied by an a.c. source of 100 V rms. The circuit has a resistance of 10 Ω, inductor of 12 Ω reactance and capacitance of 8 Ω reactance connected in series. Compute the active power and power factor of the circuit. [6]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

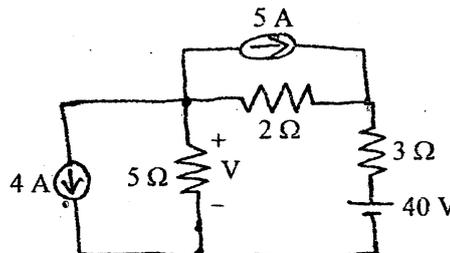
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

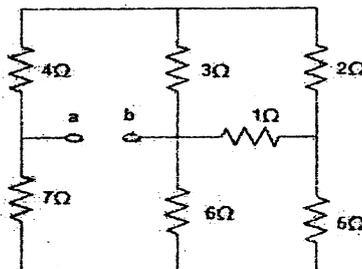
1. a) A coil connected to a constant DC supply of 100 V drew a current of 13 A at room temperature of 25°C. After some time, its temperature increased to 70°C and current fell to 8.5 A. Find the current it will draw when its temperature will further rise to 80°C. Also find the temperature coefficient of resistance of the coil at 20°C. [6]
- b) Given the information provided in figure, calculate R_3 , E , I and I_2 . Equivalent resistance of the circuit is 4 Ω. [5]



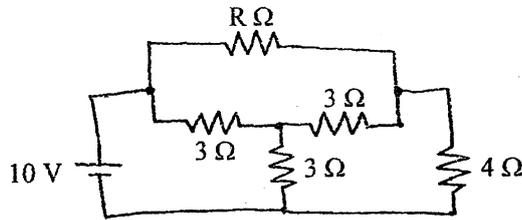
- c) Apply superposition theorem to the circuit shown below to find the voltage drop V across the 5 Ω resistor. [5]



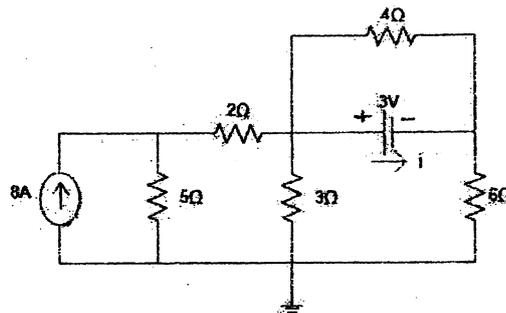
2. a) Why does the terminal voltage of a real voltage source decrease with increase in load current? Explain how a practical voltage source can be converted into a practical current source. [6]
- b) Using star-delta transformation, find the equivalent resistance between terminals 'a' and 'b'. [6]



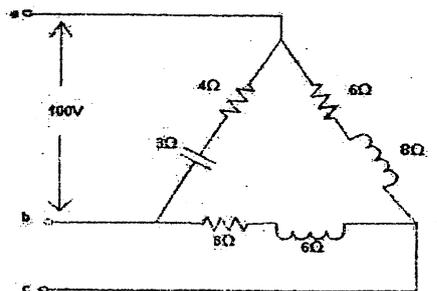
- c) A capacitor with capacitance of $2 \mu\text{F}$ is connected in series with another capacitor whose capacitance is C_x . If the equivalent capacitance of the combination is $1.5 \mu\text{F}$, calculate the value of C_x . What would be the equivalent capacitance if they were connected in parallel? [4]
3. a) Determine the value of R in the given network such that 4Ω resistor consumes maximum power. [5]



- b) Find the value of 'I' through the voltage source using Nodal analysis. [8]



4. a) An alternating current of frequency 50 Hz has a maximum value of 120 A. Write down the equation for its instantaneous value. Find also the instantaneous value after $1/360$ sec and the time taken to reach 96 A for the first time. [6]
- b) A coil is connected in series with a resistance of 30Ω across 240 V, 50 Hz power supply. The reading of a voltmeter across coil is 180 V and across resistor is 130 V. Calculate resistance and reactance of coil. Also find power factor of whole circuit. [6]
- c) Construct a phasor diagram of currents and voltages in a R-L-C series circuit. Assume $R = |0.8X_L| = |X_C|$. [4]
5. a) Explain disadvantages and causes of low power factor. [4]
- b) A series combination resistor R and inductance L is driven by 25 V, 50 Hz supply. The power delivered to R and L are 100 W and 75 VAR. Determine the value of capacitance of a capacitor to be connected in parallel with source to improve its power factor to 0.9 (lagging). [5]
- c) Discuss the advantages of three phase ac system over single phase ac system. For the given unbalanced delta connected load, find the phase currents, line currents and total power consumed by the load when phase sequence is abc. Construct the phasor diagram of currents and voltages in the load. [2+6+2]

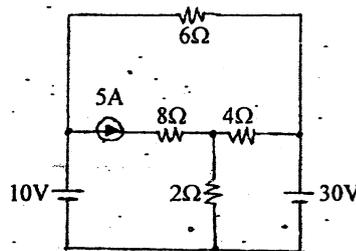


Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

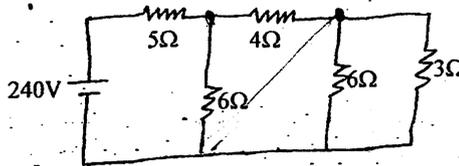
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

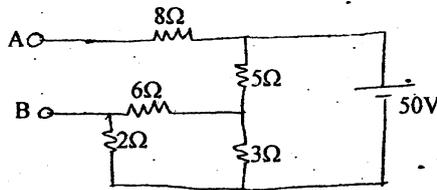
1. a) Distinguish between series and parallel connection of resistances. Derive the equation for finding equivalent resistance of three resistances connected in (i) series (ii) Parallel. [4]
- b) Find all branch currents using mesh analysis method in the following circuits. [6]



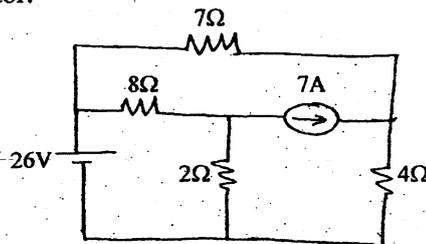
- c) Find the circuit current and current through each branch using branch current method. [6]



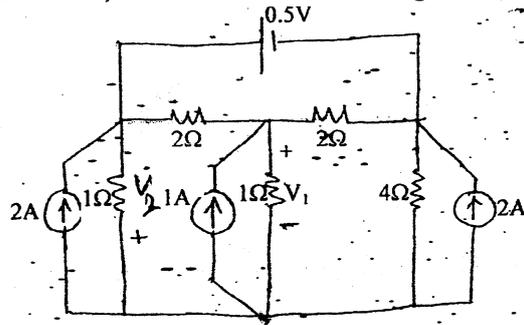
2. a) Find the Norton's equivalent resistance between the terminals A and B in the given circuit. [4]



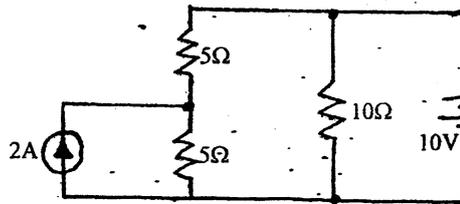
- b) Use mesh analysis to find the current flowing through 2Ω resistor and the potential across the 4Ω resistor. [6]



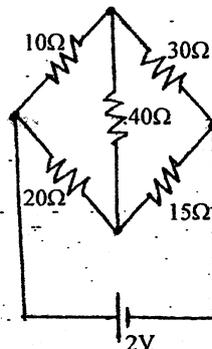
c) Find the values of V_1 , V_2 and the current flowing through the 4Ω resistor. [6]



3. a) Using superposition theorem, determine currents in all the resistors of the following circuit. [6]



b) The resistance of the various arms of a wheat stone bridge are shown in figure below. The battery has an emf of 2V. Using Thevenin's theorem, determine the value and direction of the current in the 40Ω resistor. [6]



4. Derive the expression for energy stored in an inductive coil. [4]

4. a) Two currents i_1 and i_2 are given as, $i_1 = 10 \sin(314t + \pi/14)$ A and $i_2 = 8 \sin(313t - \pi/3)$ A. Find (i) $i_1 + i_2$ and (ii) $i_1 - i_2$. Write answer in sinusoidal form. Also draw phasor diagrams of the processes. [4+4]

b) Two impedances $Z_1 = (10+j5)$ and $Z_2 = (8+j6)$ are joined in parallel across a voltage of $V = 200 + j0$. Calculate magnitudes and phases of circuit current and branch currents. Draw phasor diagram. [8]

5. a) An inductive load of 4 KW at a lagging power factor of 0.8 is connected across a 220V, 50Hz supply. Calculate the value of the capacitance to be connected in parallel with the load to bring the resultant power factor to 0.95 lagging. [4]

b) Three impedances of $(10+j10)\Omega$, $(12+j12)\Omega$ and $(2+j2)\Omega$ are connected in delta to a 3-phase system with line voltage 400V. Calculate all the phase currents, line currents, active powers, reactive powers and apparent powers. [8]

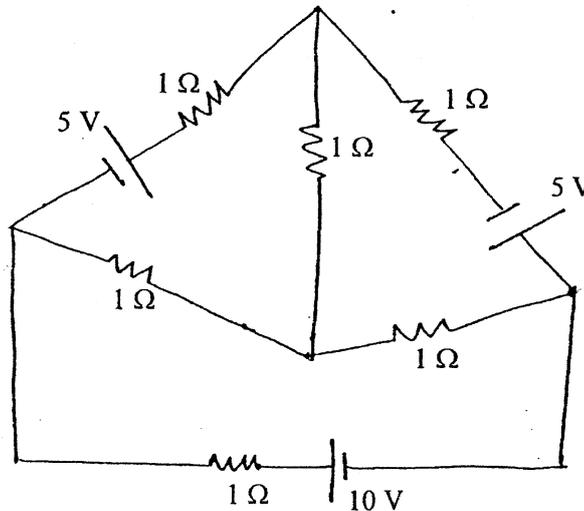
c) Explain two wattmeter method for a balanced star connected load. How can this method be used for measurement of three phase power. [4]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

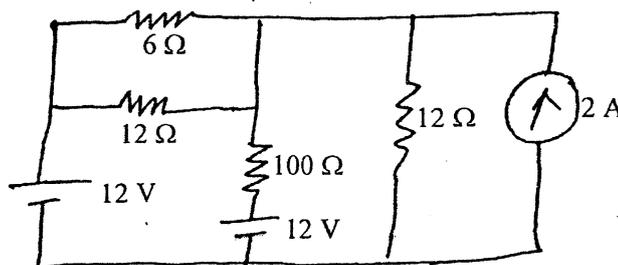
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

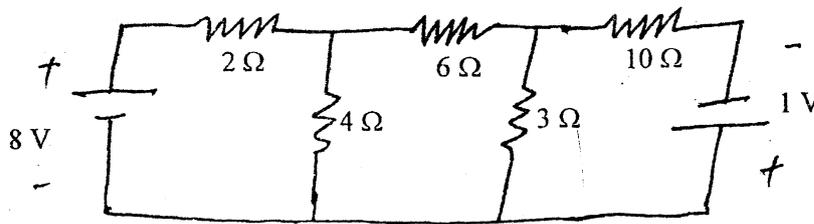
1. a) What are ideal current and voltage sources and explain how do they differ from the practical ones? [4]
- b) A piece of resistance wire, 15.6 m long of cross-sectional area 12 mm^2 at a temperature of 0°C , passes a current of 7.9 A when connected to DC supply at 240 V. Calculate (i) resistivity of the wire (ii) the current when the temperature rises to 55°C . The temperature coefficient of the wire is $0.00029 \Omega/\text{C}^\circ$ [6]
- c) Find the current flowing from the 10 V source using KVL. [6]



2. a) State and explain superposition theorem with an example. [4]
- b) How can a delta connected network of resistors be converted to star connection? Explain with necessary circuits and equations. [6]
- c) Use Norton's theorem to find the current through 100Ω resistor of the circuit below. [6]

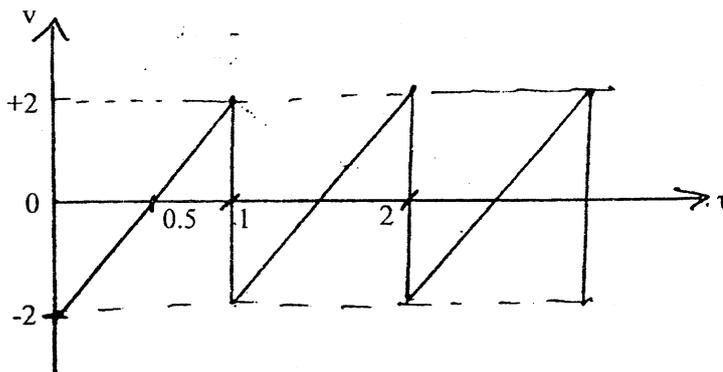


3. a) Find the voltage across the $3\ \Omega$ resistor in the following network by nodal analysis. [8]



b) Obtain the equivalent inductance when two inductors are connected in parallel both in (a) Opposition (b) Aiding nodes. [8]

4. a) Find the rms and average values of the waveform given in figure below. [4]

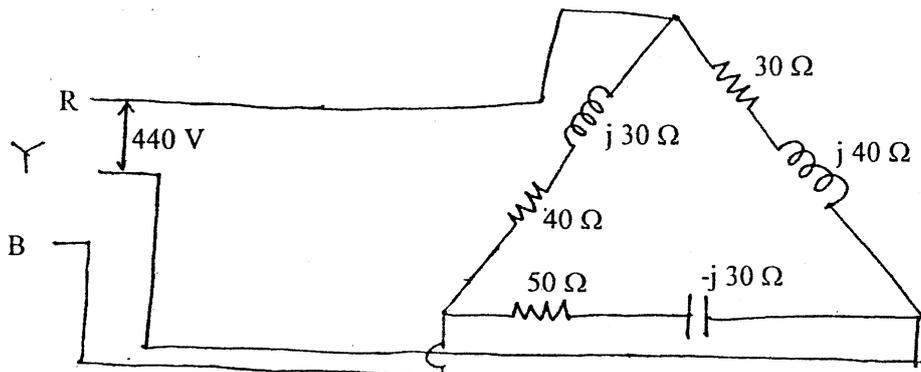


b) Define capacitance and capacitor. Explain the process of charging and discharging of capacitor with neat sketch. [4]

c) Determine the current, overall power factor, active, reactive and apparent power in each branch of the given circuit diagram. (Also draw the phasor diagram) [8]

5. a) A voltage $e(t) = 100 \sin 314 t$ is applied across series circuit consisting of $10\ \Omega$ resistance, $0.0318\ \text{H}$ inductance and a capacitor of $63.6\ \mu\text{F}$. Calculate expression for $i(t)$, phase difference between voltage and current, power factor, apparent power and active power. [8]

b) For the delta connected load, find the phase currents, line currents, power (active, reactive and apparent) in each phases. Also determine the total active power consumed. [8]

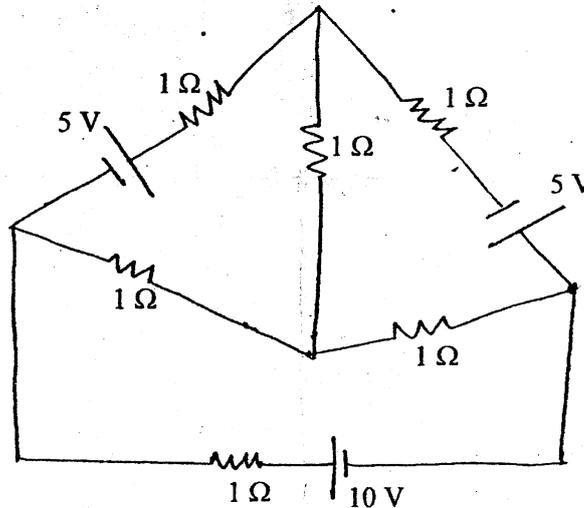


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

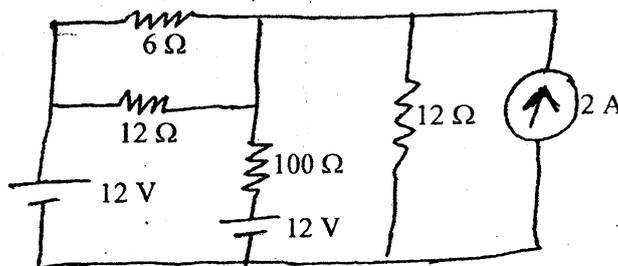
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

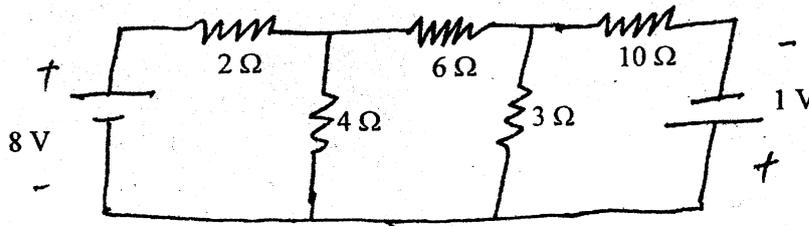
1. a) What are ideal current and voltage sources and explain how do they differ from the practical ones? [4]
- b) A piece of resistance wire, 15.6 m long of cross-sectional area 12 mm^2 at a temperature of 0°C , passes a current of 7.9 A when connected to DC supply at 240 V. Calculate (i) resistivity of the wire (ii) the current when the temperature rises to 55°C . The temperature coefficient of the wire is $0.00029 \Omega/\text{C}^\circ$ [6]
- c) Find the current flowing from the 10 V source using KVL. [6]



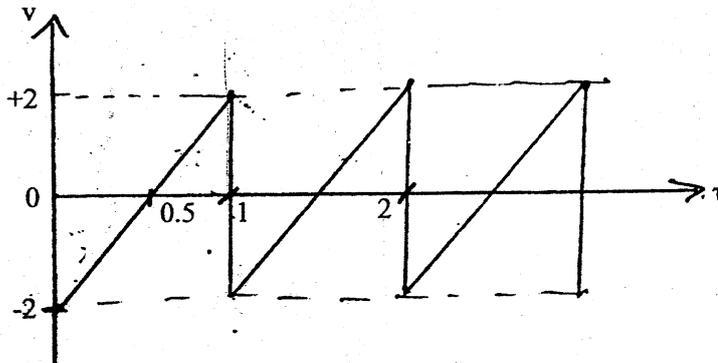
2. a) State and explain superposition theorem with an example. [4]
- b) How can a delta connected network of resistors be converted to star connection? Explain with necessary circuits and equations. [6]
- c) Use Norton's theorem to find the current through 100Ω resistor of the circuit below. [6]



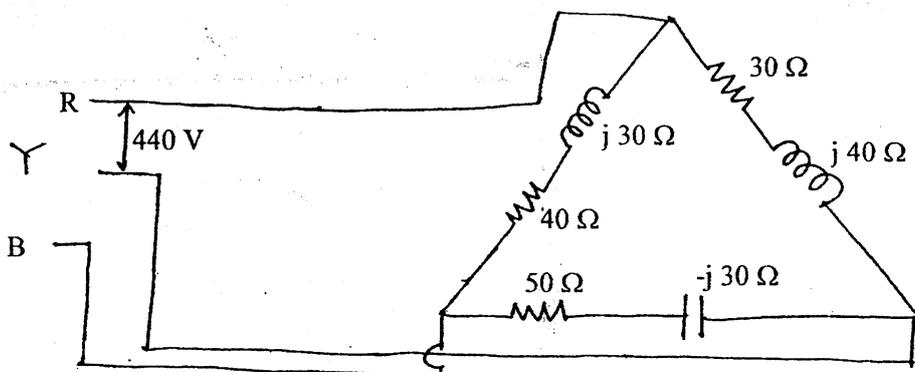
3. a) Find the voltage across the $3\ \Omega$ resistor in the following network by nodal analysis. [8]



- b) Obtain the equivalent inductance when two inductors are connected in parallel both in (a) Opposition (b) Aiding nodes. [8]
4. a) Find the rms and average values of the waveform given in figure below. [4]



- b) Define capacitance and capacitor. Explain the process of charging and discharging of capacitor with neat sketch. [4]
- c) ~~Determine the current,~~ ^{Define} overall power factor, active, reactive and apparent power in each branch of the given circuit diagram. Also draw the phasor diagram. [8] *AC Circuit*
5. a) A voltage $e(t) = 100 \sin 314 t$ is applied across series circuit consisting of $10\ \Omega$ resistance, $0.0318\ \text{H}$ inductance and a capacitor of $63.6\ \mu\text{F}$. Calculate expression for $i(t)$, phase difference between voltage and current, power factor, apparent power and active power. [8]
- b) For the delta connected load, find the phase currents, line currents, power (active, reactive and apparent) in each phases. Also determine the total active power consumed. [8]

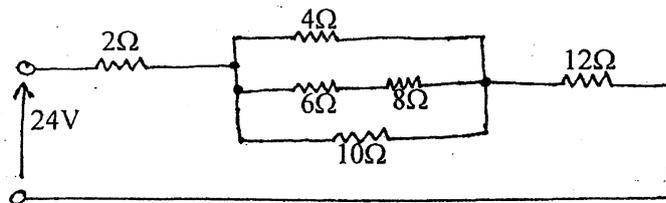


Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

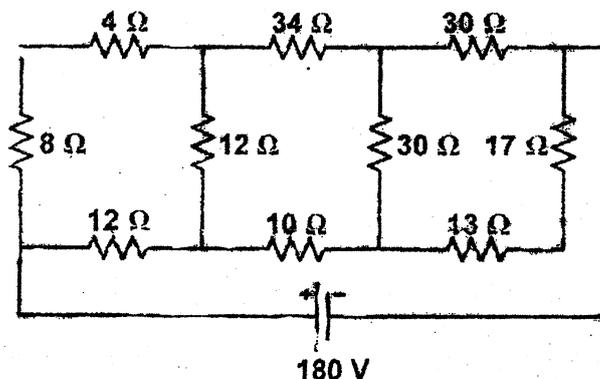
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

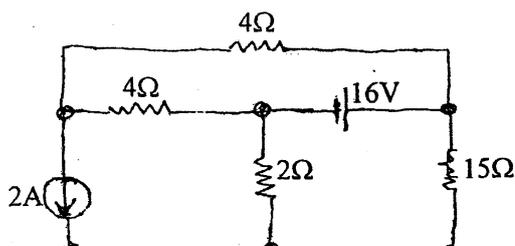
1. a) What do you mean by ideal and practical voltage source? Explain the effect of an internal resistance of a voltage source on its terminal characteristic. [4]
- b) A 230V metal filament lamp has its filament 50cm long with cross-sectional area of $3 \times 10^{-6} \text{ cm}^2$. Specific resistance of the filament metal at 20°C is $4 \times 10^{-6} \Omega\text{cm}$. If the working temperature of the filament is 2000°C , find the wattage of the lamp. Temperature coefficient of resistance of the filament material at 20°C is 0.0055 per degree centigrade. [6]
- c) Find the equivalent resistance in the figure below, and power dissipated in the 10Ω resistor. [6]



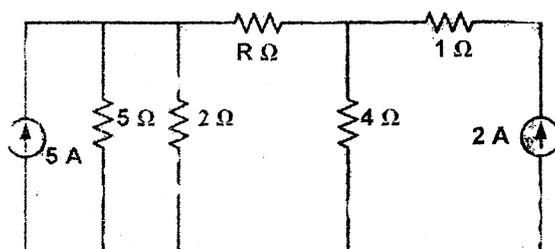
2. a) Determine the value of current in 10 Ohm resistor in the network shown in figure below using Star/Delta conversions. [6]



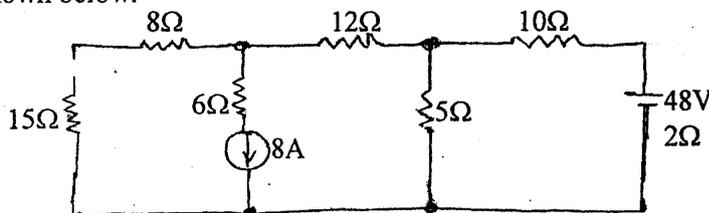
- b) Use Thevenin's theorem to find the current flowing through 15Ω resistor of the network of figure below. [6]



- c) State Norton's theorem and list the steps for Nortonizing a circuit. [4]
3. a) Find the value of R such that maximum power transfer takes place from the current sources to the load R in figure below. Obtain the amount of power transfer. [8]



- b) Use mesh current method to calculate the current through the 15Ω resistor in the figure shown below. [8]



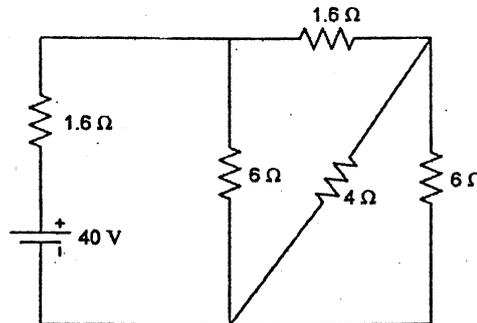
4. a) Two capacitors, A and B are connected in series across a 200V d.c. supply. The p.d. across A is 120V. This p.d. is increased to 140V, when a $3\mu\text{F}$ capacitor is connected in parallel with B. Calculate the capacitances of A and B. [4]
- b) Describe phasor representation and addition of two sinusoids $i_3 = i_1 + i_2$. Illustrate: [6]
- i) Position of the phasors for $t = 0$
- ii) Sinusoidal waveform for increasing time.
- c) In a certain circuit, supplied from 50Hz mains, the potential difference has a maximum of 500V, and the current has a maximum value of 10A. At $t = 0$, the instantaneous values of p.d., and current are 400V, and 4A respectively, both increasing positively. Assuming sinusoidal variation, obtain the expression for p.d., and current. Calculate the instantaneous values of the same at $t = 0.015\text{s}$, and find the phase difference between them. [6]
5. a) Three impedances of $(100 + j0)\Omega$, $(100 - j40)\Omega$ and $(100 + j60)\Omega$ are connected in star to a 3-phase, 4 wire system for which the phase voltage is 100V and its frequency is 60Hz. Calculate the three line currents, active, reactive and apparent power per phase. Also find the current through the neutral wire. [8]
- b) A voltage of $200\angle 53.8^\circ$ is applied across two impedances in parallel. The values of impedances are $(12 + j16)$ Ohm and $(10 - j20)$ Ohm. Determine: (i) Total impedance (ii) total current drawn from the circuit (iii) Current flowing through each parallel branch (iv) Power factor of the whole circuit (v) Active, reactive and apparent power. Draw the phasor diagram. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

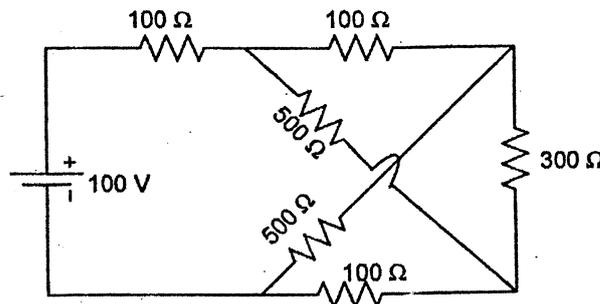
Subject: - Basic Electrical Engineering

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

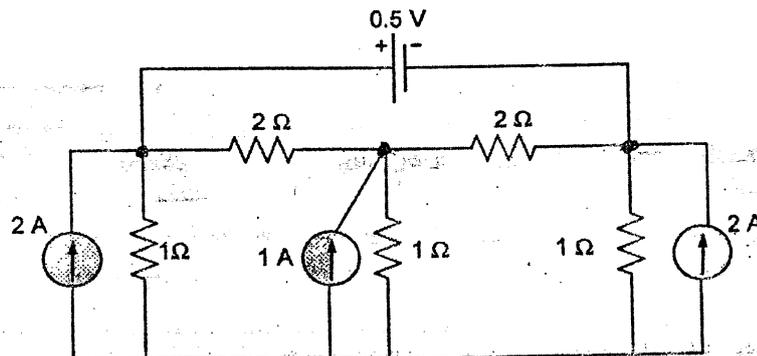
1. a) What do you mean by ideal and practical voltage source? Explain the effect of an internal resistance of a voltage source on its terminal characteristics. [2+3]
- b) The coil of a relay takes a current of 0.12A when it is at the room temperature of 15°C and connected across a 60-V supply. If the minimum operating current of the relay is 0.1A, calculate the temperature above which the relay will fail to operate when connected to the same supply. Resistance-temperature coefficient of the coil material is 0.0043 per °C at 6°C. [6]
- c) Find the current through 4Ω resistance. [5]



2. a) State and explain Kirchoff's laws. Determine the current supplied by the battery in the circuit shown in figure below. [2+4]

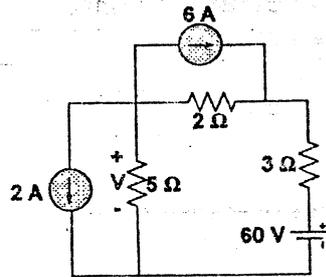


- b) Obtain the voltages at each nodes by applying nodal voltage analysis. [6]

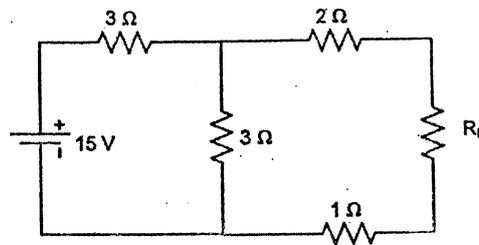


- c) State and explain Norton's theorem with an appropriate example. [4]

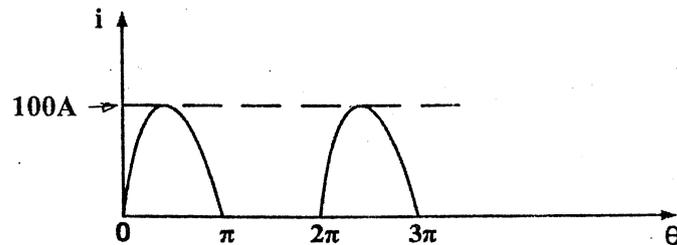
3. a) State superposition theorem. Apply superposition theorem to the circuit shown below to find the voltage drop V across the 5Ω resistor. [8]



- b) Find the value of R_L such that maximum power will be transferred to R_L . Find the value of the maximum power. [8]



4. a) Derive the equation for instantaneous current flowing through a pure capacitor when excited by AC sinusoidal voltage $v = V_m \sin \omega t$. Draw the waveform of voltage and current and phasor diagram of the circuit. Show analytically and graphically that it does not consume real power. [4]
- b) Calculate the RMS and average values of the rectified sine wave of 50Hz. [6]



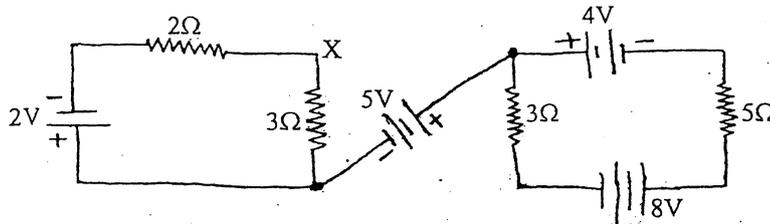
- c) Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3 kW and 2 kVAR, find the inductance of A and the resistance of B. Calculate the voltage across each coil. [6]
5. a) Two impedances consists of (resistance of 15Ω and series connected inductance of 0.04H) and (resistance of 10Ω , inductance of 0.1 H and a capacitance of $100\mu\text{F}$, all in series) are connected in series and are connected to a 230V, 50Hz a.c. source. Find: (i) current drawn, (ii) voltage across each impedance, (iii) total power factor and (iv) draw the phasor diagram. [6]
- b) What are the two ways of connecting a 3-phase system? Draw their phasor diagrams and write down the relationship between phase and line voltages and currents for these systems. [4]
- c) Define power factor and explain the disadvantages and causes of low power factor? [6]
6. a) List out the advantages of 3 phase system over single phase system. [4]
- b) Explain 2-wattmeter method for the measurement of power in a balanced three phase load. How are the readings of the two wattmeters affected, when the load power factors is very low. [6]
- c) A 220V, 3-phase voltage is applied to balanced delta connected 3-phase load of phase impedance $(15 + j20)\Omega$. Calculate: [6]
- The phase voltages
 - The power current in each line
 - The power consumed per phase
 - Draw the phasor diagram
 - What is the phasor sum of three line currents? Why does it have this value?

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

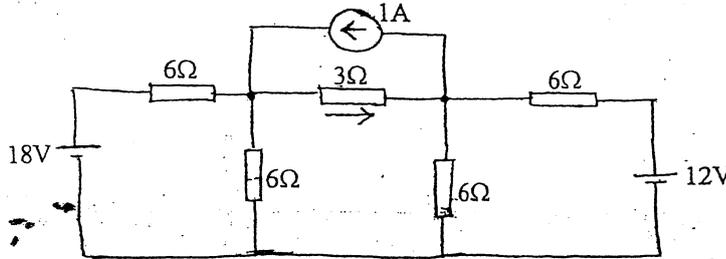
Subject: - Basic Electrical Engineering

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

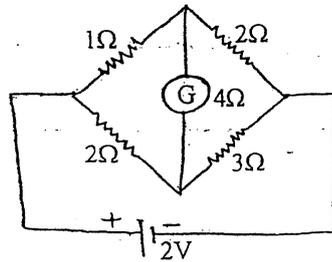
1. a) What do you understand by an ideal current source? How can it be made a practical current sources and why should we do that? [6]
- b) What is the difference of potential between X and Y in the network shown in figure below. [5]



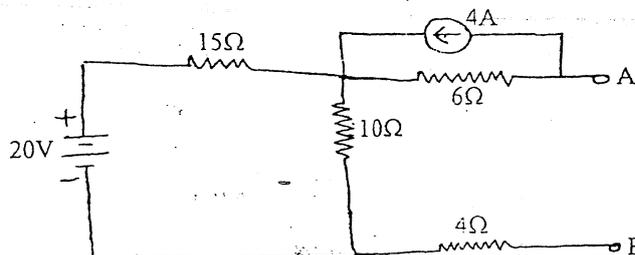
- c) A coil is connected across a constant dc source of 120V. It draws a current of 12 Amp at room temperature of 25°C. After 5 hours of operation, its temperature rises to 65°C and current reduces to 8 Amp. Calculate: [5]
- i) Current when its temperature has increased to 80°C
 - ii) Temperature coefficient of resistance at 30°C
2. a) Find the current I in the circuit of figure given below by applying nodal voltage analysis. [6]



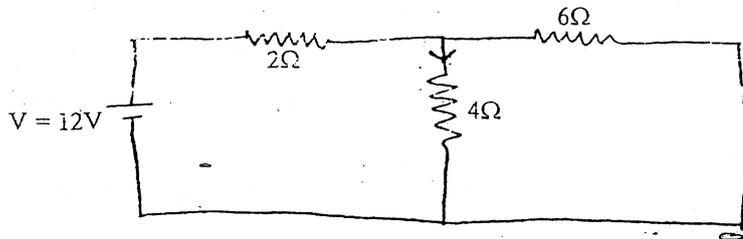
- b) Calculate the current through the galvanometer in the bridge circuit as shown in figure given below using Kirchhoff's laws. [6]



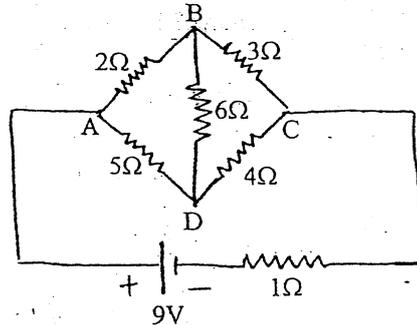
- c) State Thevenin's theorem and find the Thevenin's equivalent circuit for terminal pair AB of the network shown in figure given below. [4]



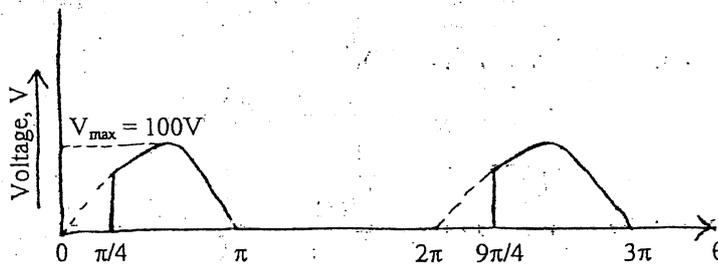
3. a) State reciprocity theorem. Verify the theorem in the network given below. [4]



- b) Calculate the current in the 6Ω resistor in the network shown below using Norton's theorem. [8]



- c) Why do we express an ac voltage or current by its RMS value? Discuss. [4]
4. a) In a purely inductive circuit when excited by a sinusoidal voltage, show mathematically and graphically, that the current lags the applied voltage by 90° and also show that the average power consumed in the inductor is zero. [6]
- b) Determine the average and r.m.s. values of voltage for sinusoidal voltage waveform as shown in figure below. [6]



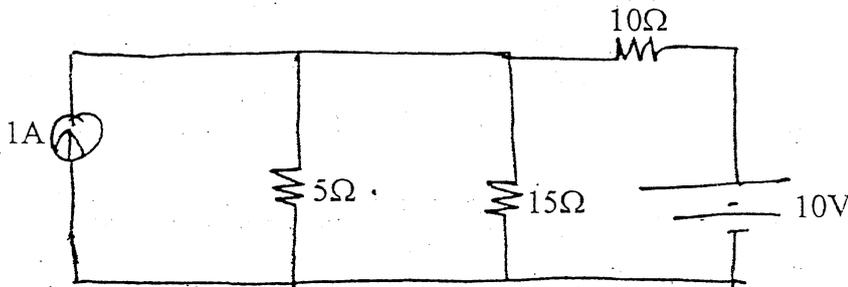
- c) Explain with diagrams what do you understand by [4]
- i) In phase
 - ii) Lagging and
 - iii) Leading quantities applied to sinusoidal ac system.
5. a) An emf, $e_0 = 141.4 \sin(377t + 30^\circ)$ is impressed on the impedance coil having a resistance of 4Ω and an inductive reactance of 1.25Ω measured at 25Hz. What is the equation of the current? Also find the equation for the resistive drop e_R and inductive drop e_L . [6]
- b) Define power factor. Explain the requirement and the method of its correction. [6]
- c) List out the advantages of 3- ϕ system over single phase system. [4]
6. a) A balanced star connected load with impedance $(10+j5)\Omega$ per phase is fed from a balanced 3 phase 400 volt supply. Calculate: [8]
- i) The phase voltages
 - ii) The line currents
 - iii) The power absorbed and
 - iv) Draw the phasor diagram
- b) Explain 2-wattmeter method for the measurement of power in a balanced three phase load. How are the readings of the two wattmeters affected, when the load is purely resistive? [8]

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

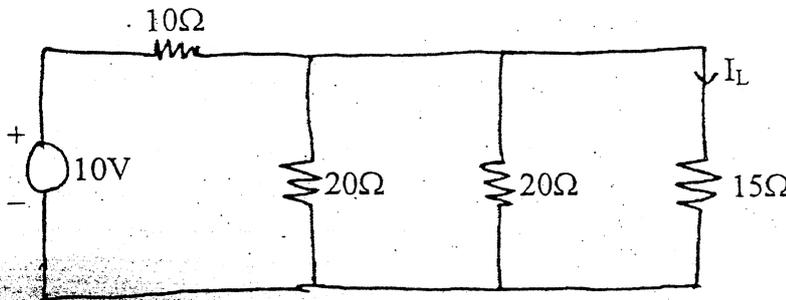
Subject: - Basic Electrical Engineering

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

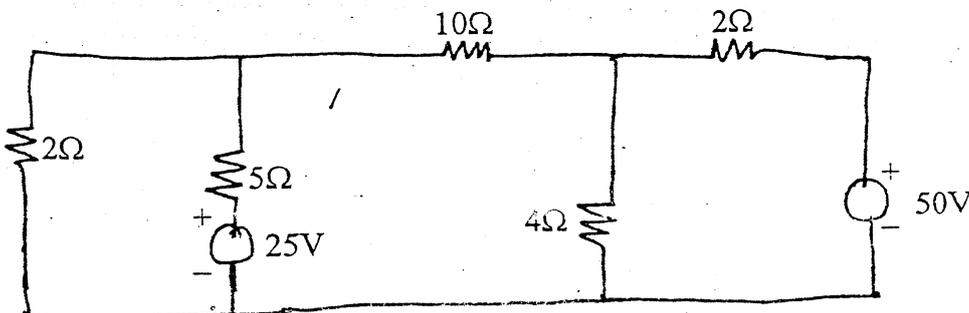
1. a) The temperature rise of the machine field winding was determined by the measurement of the winding resistance. At 20°C the field resistance was 150 ohm. After running the m/c for 6 hours at full load, the resistance was found to be 175 ohm. If the temperature coefficients of resistance of the copper winding is $1.57 \times 10^{-5}/^{\circ}\text{C}$ at 0°C, determine the temperature rise of the machine.
- b) What are ideal and practical voltage and current sources? Explain.
2. a) Calculate the current in the 15Ω resistor in the network shown in figure below using superposition theorem.



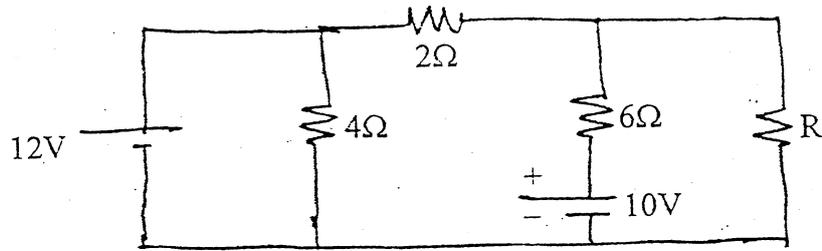
- b) Determine the current I_L through 15Ω resistor in the network by Norton's theorem.



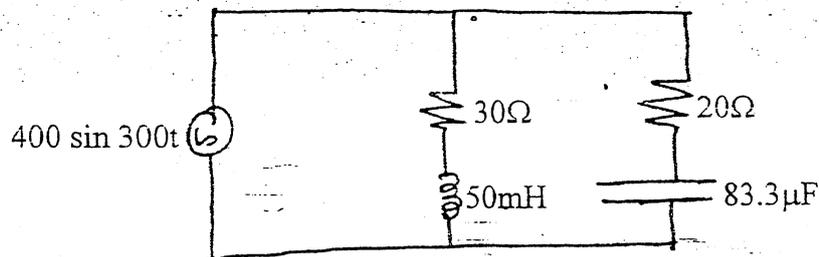
3. a) Use nodal method to find the current through 10Ω resistor for circuit shown below.



- b) Calculate the value of R to receive maximum power and the maximum power received by it for the circuit shown below.



4. a) A series circuit consists of a resistance equal to 4Ω and inductance of 0.01H . The applied voltage is $v = 283 \sin(300t + 90^\circ)$ volts. Find
- The power dissipated in the circuit
 - The expression for $i(t)$
 - Power factor and
 - Draw a phasor diagram
- b) For the circuit below, calculate
- Magnitude and phase angles of current in each of the branches,
 - Active, reactive and apparent power and power factor of the circuit, and
 - Draw the vector diagram indicating branch currents and supply voltage



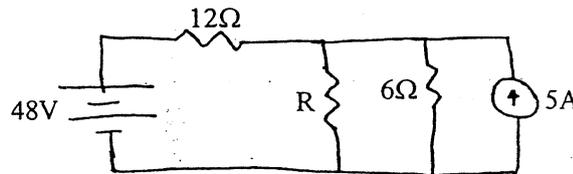
5. a) Describe the advantages of three phase AC system over single-phase AC system.
- b) Three phase balanced load consists of three similar coils, each of resistance 50Ω and inductance of 0.3H . The supply voltage is 415V , 50Hz . Calculate (i) The line current (ii) The power factor (iii) Total power consumed and (iv) Draw the phasor diagram. Take R×B as phase sequence.
6. a) Define power factor and explain the disadvantages and causes of low power factor?
- b) A single-phase 50Hz motor takes 20A at 0.65 power factor lagging from a 230V sinusoidal supply. Calculate the KVar rating and capacitance to be connected in parallel to raise the power factor to 0.9 lagging. What is the new supply current?

Exam.	Regular/Back	
	Level	BE
Programme	BEL, BEX, BCT	Pass Marks 32
Year / Part	I / II	Time 3 hrs.

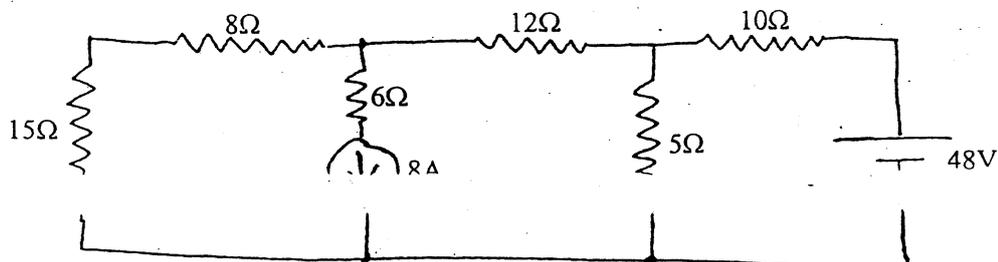
Subject: - Electrical Circuits I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

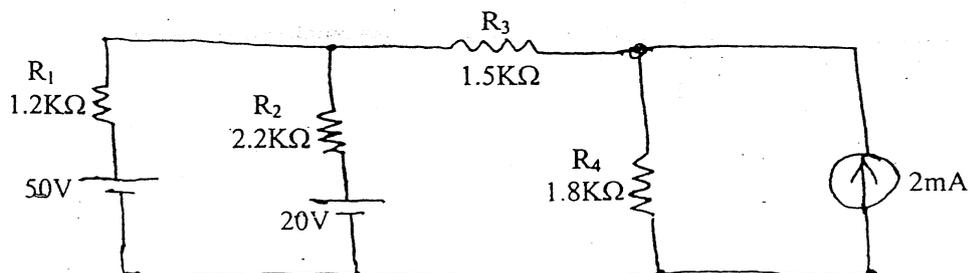
1. a) What do you mean by ideal and practical current source? Explain the effect of an internal resistance of a current source on its terminal characteristics. [4]
- b) A 1 km length of wire having a diameter of 11.7mm and of resistance 0.031Ω is drawn so that its diameter becomes 5mm. What does its resistance becomes? [6]
- c) An inductor is to be made with a copper wire wound on an iron core having mean length of 50cm with a cross-sectional area of 60mm^2 . If the required value of inductance is 70 mH, calculate the number of turns required. It is given that the relative permeability of the core is 1400. [6]
2. a) State and explain Reciprocity Theorem with suitable example. [4]
- b) Calculate the value R that will absorb maximum power from the circuit shown in figure below. Also calculate the maximum power drawn by it. [6]



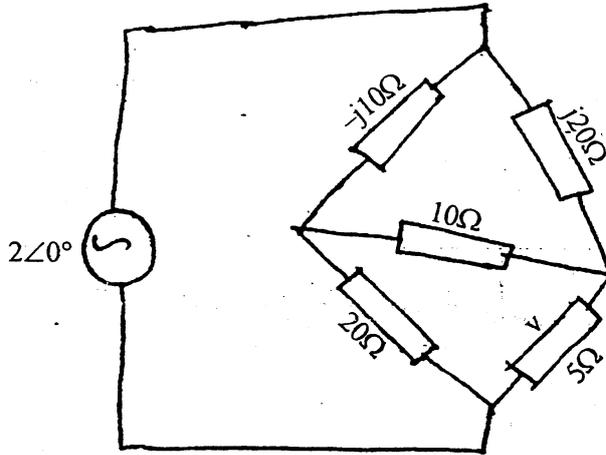
- c) Calculate the current through 15Ω resistor in figure given below. [6]



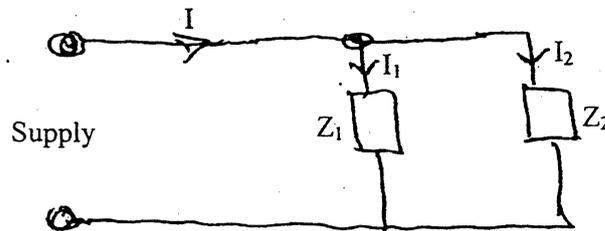
3. a) Using nodal analysis, determine the current that flows through resistor R_3 . [8]



- b) For a three-phase balanced load, write equations for (i) reactive power per phase, (ii) total load reactive power in terms of V_L and I_L , (iii) apparent power per phase, (iv) total apparent power in terms of V_P and I_P , (v) total apparent power in terms of V_L and I_L and (vi) $\cos\theta$. Briefly explain each equation. [8]
4. a) Derive the equation for instantaneous current flowing through a pure inductor when excited by AC sinusoidal voltage $V = V_m \sin \omega t$. Draw the waveform of voltage and current and phasor diagram of the circuit. Show analytically and graphically that it does not consume real power. [3+2+3]
- b) For the circuit diagram shown below, determine the voltage V across the 5Ω impedance and specify it in time domain when $\omega = 2000$ rad/s. [8]



5. a) The power input to a motor is measured by two wattmeters, which indicate 40KW and 50KW respectively. If the power factor of the motor be changed to 0.8 leading, determine the reading of two wattmeters. The total input power remains the same. Draw vector diagram for the second condition of load. [6]
- b) Explain the importance of power factor in an ac circuit, with suitable example. How power factor can be improved? [4]
- c) The two impedances in the circuit shown in figure below are $Z_1 = (1K + j2.7K)\Omega$ and $Z_2 = (790 - j1.6K)\Omega$. The total current taken from the supply is 15 mA. Calculate the two branch currents. [6]



Examination Control Division

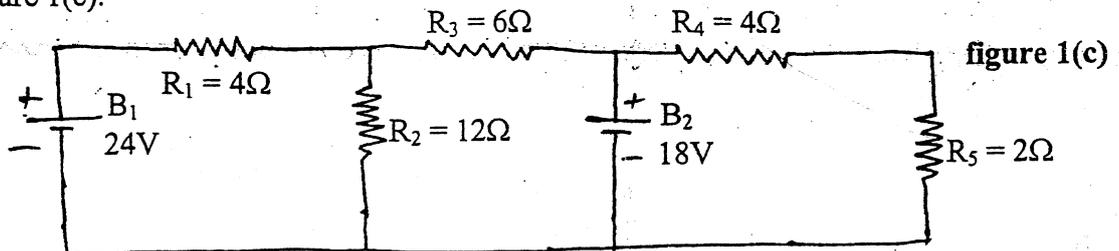
2065 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

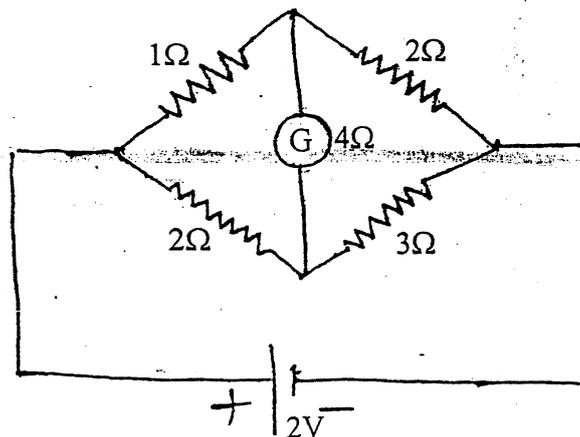
Subject: - Electrical Circuits I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain the effect of internal resistance of a current source upon its terminal characteristics. [4]
- b) An aluminium wire 7.5m long is connected in parallel with a copper wire 6m long. When a current of 5A is passed through the parallel combination, it is found that the current in the aluminium wire is 3A. The diameter of aluminium wire is 1mm. Determine the diameter of copper wire the resistivity of copper is $0.017\mu\Omega\text{-m}$ and that of aluminium is $0.028\mu\Omega\text{-m}$. [6]
- c) Using superposition theorem, find the current in resistor R_3 in the circuit shown in figure 1(c). [6]



2. a) Using Kirchhoff's law, calculate the current through the galvanometer in the bridge circuit shown in figure 2(a). [6]



- b) State and explain Norton's theorem with an appropriate example. [4]
- c) Consider the circuit shown in the figure 2(c). Determine [6]
 - i) the value of R so that the load of 20Ω should draw maximum power.
 - ii) the value of maximum power drawn by the load.

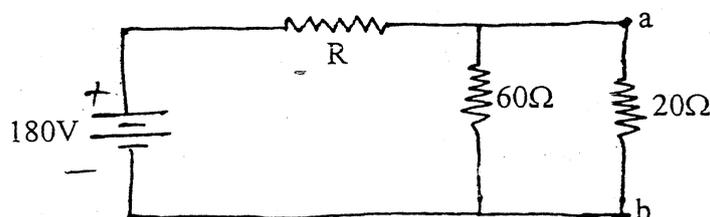
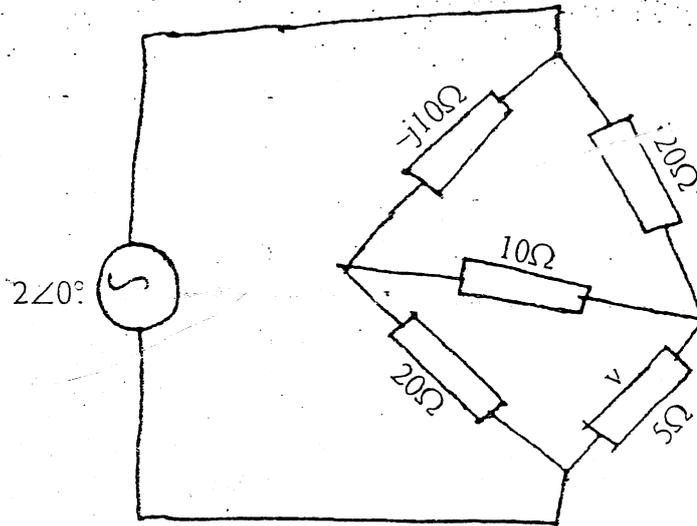
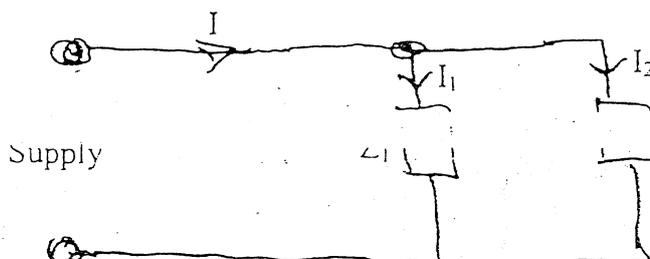


figure 2(c)

- b) For a three-phase balanced load, write equations for (i) reactive power per phase, (ii) total load reactive power in terms of V_L and I_L , (iii) apparent power per phase, (iv) total apparent power in terms of V_P and I_P , (v) total apparent power in terms of V_L and I_L and (vi) $\cos\theta$. Briefly explain each equation. [8]
4. a) Derive the equation for instantaneous current flowing through a pure inductor when excited by AC sinusoidal voltage $V = V_m \sin\omega t$. Draw the waveform of voltage and current and phasor diagram of the circuit. Show analytically and graphically that it does not consume real power. [3+2+3]
- b) For the circuit diagram shown below, determine the voltage V across the 5Ω impedance and specify it in time domain when $\omega = 2000$ rad/s. [8]



5. a) The power input to a motor is measured by two wattmeters, which indicate 40KW and 50KW respectively. If the power factor of the motor be changed to 0.8 leading, determine the reading of two wattmeters. The total input power remains the same. Draw vector diagram for the second condition of load. [6]
- b) Explain the importance of power factor in an ac circuit, with suitable example. How power factor can be improved? [4]
- c) The two impedances in the circuit shown in figure below are $Z_1 = (1K + j2.7K)\Omega$ and $Z_2 = (790 - j1.6K)\Omega$. The total current taken from the supply is 15 mA. Calculate the two branch currents. [6]



Examination Control Division

2071 Bhadra

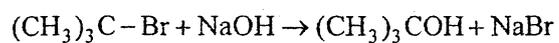
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Chemistry (SH453)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define buffer capacity and buffer range. Calculate the concentration of sodium benzoate that must be present in 0.1 M benzoic acid to make a buffer solution of pH 3.7 (K_a for benzoic acid is 1.8×10^{-4}) [2+3]
2. What is electrode potential? How does it originate? What will be the reduction potential of Zn^{2+}/Zn electrode when zinc metal in contact with 0.1 M H_2SO_4 at $25^\circ C$. Given $E^0_{Zn/Zn^{2+}} = +0.768V$. [1+1+3]
3. Define heterogenous catalysis. Describe the absorption theory of catalysis with suitable example. Write any two criteria of choosing catalyst for industrial purpose. [1+3+1]
4. Global warming is one of the burning issues of the world. Point out major causes of global warming, its impacts and also control measures. [1+2+2]
5. What do you mean by water pollution? What are the major water pollutants, mention their adverse effects. [1+2+2]
6. Explain preparation and uses of polyphosphazenes and polymeric sulfur nitride. [2.5+2.5]
7. What is biodegradable polymer? Mention preparation and uses of the following. [1+2+2]
 - a) Epoxy resin
 - b) Polyurethane
8. Give reasons for [2.5+2.5]
 - a) Cu(I) is diamagnetic where as Cu(II) is paramagnetic.
 - b) TiO_2 is white but $TiCl_3$ is violet.
9. Give reasons: [2.5×2]
 - a) The components formed by symbol 'V' element in +5 oxidation state are colourless but those formed in +3 oxidation state are colourful.
 - b) Transition elements are mostly paramagnetic.
10. What do you mean by effective atomic number? Give IUPAC name and calculate the effective atomic number of the following complexes. [1+4]
 - a) $[Fe(CN)_6]^{3-}$
 - b) $[Ag(NH_3)_4]^+$
 - c) $[Ni(CN)_4]^{2-}$
 - d) $[Cr(H_2O)_6]^{2+}$
11. What are the inner orbital and outer orbital complexes? Explain formation of $[Fe(CN)_6]^{4-}$ on the basis of valance bond theory and predict its magnetic behavior. [2+3]

12. Explain why SN^1 reaction gives both retention and inversion isomers but SN^2 gives only inversion isomer. Write the mechanism of given chemical reaction. [2+3]



(aa)

13. Distinguish between enantiomers and diastereomers. Show these isomers in 3-bromo-2-butanol. [2+3]
14. What is an explosive? Classify explosives with examples. What is the requirement of good explosives? [1+2+2]
15. What are elimination reactions? Write the differences between E_1 and E_2 reaction mechanism taking suitable example. [1+4]
16. a) What is lubricant? Write about the application of different types of lubricants. [1+2]
- b) Write the characteristics of good paint. [2]

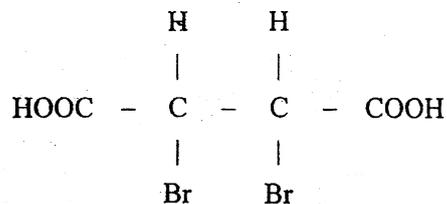
Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Chemistry (SH453)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. How does electrode potential originate? Define standard electrode potential. Write the cell notation and cell reaction of Zn-Cu cell. [2+1+2]
2. What is meant by buffer solution? Calculate the concentration of sodium formate, HCOONa, that must be present in a 0.10M solution of formic acid to produce a pH of 3.80. [K_a for formic acid is 1.8×10^{-4}]. [1+4]
3. Explain the terms: (a) Homogeneous catalysis (b) Catalytic poisoning (c) Promoters. [2+1.5+1.5]
4. What are major gases responsible for causing green house effect and how are they released into the atmosphere? Give an account of the global efforts to control the release of these gases. [1+2+2]
5. What are the main sources of water pollution? Write the effect of water pollution on mankind. Mention the measures to control water pollution. [1+2+2]
6. Write short notes on: (a) Sulphur based polymers (b) Polyphosphazines. [3+2]
7. a) What are monomers of: (i) Polyurethane (ii) Nylon 6,6 (iii) Bakelite (iv) Epoxy resin. [2]
b) What are the engineering application of : (i) Polyvinyl chloride (ii) Conducting polymer.
8. Why do transition metals: (i) Form complex compound (ii) Exhibit variable oxidation states. [1+2+2]
9. Why are 3d-series elements called transition elements? Give their characteristic on the basis of valency. [2+3]
10. Differentiate between low spin and high spin complexes. Explain the geometry and magnetic behaviour of $[\text{Ni}(\text{CO})_4]^0$ on the basis of valence bond theory. [2+3]
11. a) Differentiate between complex salts and double salts. Calculate EAN of the central metal atom in $\text{Fe}(\text{CN})_6$ [2.5×2]
b) Write the IUPAC name of the following co-ordination compounds.
(i) $\text{K}[\text{PtCl}_5(\text{NH}_3)]$ (ii) $[\text{CO}(\text{NH}_3)_5\text{SO}_4]\text{Br}$
12. a) Mention the importance of primary and low explosives. Give the preparation and uses of TNT and TNG. [5]
13. a) What are lubricating greases? Give their functions. [1+2+2]
b) Show your acquaintance with types of paints.

14. What is optical activity? Give the stereoisomers of tartaric acid. Would you expect the following compound to be optically active? Explain. [1+3+1]



15. How do SN1 and SN2 reactions differ in haloalkane? Mention the factors which regulates the reaction. [3+2]
16. What do you mean by Elimination reactions? Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]

2068 Bhadra

Exam. Level	Regular		
	BE	Full Marks	80
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. How does a galvanic cell differ from an electrolytic cell? Calculate the emf of the following cell at 25°C giving electrode reactions and cell reaction. [1+4]

$\text{Cd(s)}|\text{Cd}^{++}(0.01\text{M})||\text{Cu}^{++}(0.5\text{M})|\text{Cu(s)}$
 $E^{\circ}_{\text{Cd}^{++}/\text{cd}} = -0.140\text{V}, E^{\circ}_{\text{Cu}^{++}/\text{cu}} = 0.34\text{V}$
2. What is a buffer solution? Discuss the mechanism of buffer action with suitable examples. [1+4]
3. What is meant by catalysis? Point out its importance. Discuss intermediate compound formation theory of catalysis with suitable examples. [1+1+3]
4. Briefly discuss sources of organic and inorganic substances responsible for water pollution. Point out their adverse effects and possible remedies. [3+2]
5. a) What is meant by global warming? Give its causes and consequences. [3]
 b) What is the photochemistry behind ozone layer depletion? [2]
6. a) What are chalcogenide glasses? Give their uses. [2.5]
 b) Give the preparation and applications of silicone rubbers. [2.5]
7. a) Give the preparation and applications of bakelite and polyurethanes. [4]
 b) What are the advantages of conducting polymers? [1]
8. a) What are transition elements? List the industrial application of 3d transition elements. [1+2]
 b) Why do transition elements show variable oxidation states? [2]
9. Explain the following features of transition elements with reference to 3d transition series: [3+2]
 - a) Formation of complex compounds
 - b) Formation of colored compounds
10. Differentiate between complex salts and double salt. How does Werner's theory explain the bonding in complex salts? [1+4]
11. Write the formulae of following: [2]
 - i) Potassium hexacyanoferrate (III)
 - ii) Trioxalatoaluminate (III) ion
 - iii) Tris (ethylenediamine) chromium (III) chloride
 - iv) Bis (benzene) chromium(0)

- b) How does valence bond theory explain the formation of $[\text{Ni}(\text{NH}_3)_6]^{2+}$? Predict its magnetic behaviour. [3]
12. What are low explosives? Write their uses. Give the preparation and applications glycerol trinitrate. [2+3]
13. a) What are lubricating oils? Indicate their importance in engineering. [2]
b) What are paints? Discuss any two types of paints indicating their applications in engineering works. [3]
14. a) What are geometrical isomers? Give an example specifying Z and E configuration. [2]
b) Show your familiarity with enantiomerism diastereomerism. [3]
15. Discuss the unimolecular nucleophilic substitution reaction mechanism in alkylhalide showing the stereochemistry. What type of solvent favors this type of mechanism? [4+1]
16. What is meant by elimination reaction? Discuss E^1 and E^2 reaction mechanisms. [1+4]

Exam.	Regular / Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate **Full Marks.***
- ✓ *Assume suitable data if necessary.*

1. What is meant by standard electrode potential? Give the electrode reactions and calculate the emf of the following cell at 25°C. [1+4]

$\text{Fe}^{2+} = \text{Fe}^{3+} + e^{-}$, $E^{\circ} = -0.77\text{V}$
 $\text{Ni}^{2+} + 2e^{-} = \text{Ni}$, $E^{\circ} = -0.25\text{V}$
 $[\text{Ni}^{2+}] = 0.2\text{M}$, $[\text{Fe}^{2+}] = 0.1\text{M}$, $[\text{Fe}^{3+}] = 1\text{M}$.
2. What is a buffer? 1.64 g of anhydrous sodium acetate is added to 200ml of 0.2M acetic acid. What is the pH of buffer? Calculate the degree of ionization of the acid in the solution. (K_a of acid = 1.8×10^{-5}) [1+4]
3. Describe the adsorption theory of catalysis with an example. How does a poison paralyze the activity of a catalyst? Give any two industrial applications of catalysts. [3+1+1]
4. Write short notes on: [3+2]
 - a) Global warming
 - b) Acid rain
5. What is meant by soil pollution? Point out the major sources of soil pollution, their adverse effect and their possible remedies. [1+2+1+1]
6. a) What are polyphosphonitrilic compounds? Give one method for the preparation of polyphosphonitrilic compound and mention the uses. [3]
 - b) What are silicones? Give any two uses of silicones. [2]
7. a) What is a thermosetting polymer? Write down the uses of epoxy resin. [2]
 - b) What are conducting and biodegradable polymers? Point out the applications of conducting polymers in engineering. [3]
8. What are transition elements? Explain the variable oxidation states exhibited by 3d series. Why does the transition elements form alloy? [1+3+1]
9. Explain the followings: [3+2]
 - a) Transition elements are good in forming complexes.
 - b) TiO_2 is white but TiCl_3 is violet
10. What is complex salt? Give the main postulates of Werner's coordination theory. [1+4]

11. a) Explain the formation of $[\text{Fe}(\text{CN})_6]^{4-}$ on the basis of valence bond approach and predict its magnetic behavior. [3]
- b) Write the IUPAC name of the followings; [2]
- i) $\text{K}_3[\text{Fe}(\text{CN})_6]$
 - ii) $\text{Na}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$
 - iii) $[\text{Co}(\text{Cl})(\text{CN})(\text{NO}_2)(\text{NH}_3)_3]$
 - iv) $[\text{Cr}(\text{NO}_3)_6]^{3-}$
12. What are characteristics of an explosive? Give the preparation of glycerol trinitrate (GTN) and trinitrotoluene (TNT). Point out the industrial applications of explosives. [1+1.5+1.5+1]
13. a) What is paint? Give the requisites of a good paint. [1+2]
- b) What are lubricating greases? Give their functions. [1+1]
14. a) Define enantiomers, racemic mixture and meso compound giving one example of each. Also comment on their optical activity. [4]
- b) Draw the structure and specify Z and E configuration of 1-Bromo-1 chloropropene. [1]
15. Explain the $\text{S}_{\text{N}}2$ reaction mechanism with reference to hydrolysis of alkylhalide. What type of solvent favors this type of path? How can you say that carbocation is not formed during $\text{S}_{\text{N}}2$ reaction? [3+1+1]
16. Write the mechanism of unimolecular elimination reaction. How does it differ from bimolecular elimination reaction? [3+2]

2067 Chaitra

Exam.	New Back (2066 Batch Only)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is normal hydrogen electrode? A galvanic cell consists of a metallic nickel plate immersed in 0.1M Ni(NO₃)₂ solution and a metallic plate of copper in 0.2M CuSO₄ solution. Calculate the emf of this cell. [2+3]
 $E^\circ_{\text{Ni}^{++}/\text{Ni}} = -0.25\text{V}$ $E^\circ_{\text{Cu}^{++}/\text{Cu}} = +0.34\text{V}$
2. What is corrosion? Calculate the pH of a resulted solution when 0.1 gm of NaOH is added to 200ml of 0.1M acetic acid solution. (pK_a = 4.74). [1+4]
3. What is catalyst? Explain positive and negative catalysis with two examples for each. [1+2+2]
4. Define heterogeneous catalysis. Give a brief account on theory of Heterogeneous catalysis. [1+4]
5. Give an account of acid rain? What are the sources of CO and SO₂ pollutants in air? How are they controlled? [1+2+2]
6. What is ozone depletion? Explain its causes. Mention the major pollutants of water? [1+2+2]
7. Differentiate thermosetting and thermoplastics polymers. Write the name and the preparation of the organic polymers that are used for (i) Preparing ropes and socks (ii) Preparing non stick cooking utensils. [2+3]
8. What is linear chain polymer? Write the preparation and uses of different types of sulphur bases inorganic polymers. [1+4]
9. What are d-block elements? Give the electronic configuration of 3d series. Mention which d block metals are not considered as transition as transition metals and why? [1+2+2]
10. Explain the following: [2+3]
 - a) Transition metals exhibit variable valency.
 - b) Transition elements are very good in forming complexes.
11. How does the valence bond theory account for the following facts? [5]
 - a) [Fe(CN)₆]⁴⁻ ion is diamagnetic but [Fe(CN)₆]³⁻ is paramagnetic
 - b) [Ni(CO)₄]⁰ is diamagnetic and tetrahedral.

12. Identify the complex ion and ligands in the compound $[\text{Co}(\text{NH}_3)_5]\text{Cl}_2$. Write the formulae of the following co-ordination compounds. [2+3]
- Dichloro tetra-aquo chromium (III) cation
 - Tris (ethylene diamine) chromium(III) chloride
 - Dicyano argentate (I) ion
 - Bromo penta-ammine cobalt (III) sulfate
 - Sod. hexa nitrito cobaltate(III)
 - Hexa-cyanoferrate (III) ion
13. Define Dynamite and plastic explosive. Write the preparation, properties and uses of Nitro cellulose. [2+3]
14. What are greases? Mention their specific uses. Write short note on varnish. [2+1+2]
15. What is optical isomerism? Comment why presence of chiral centre is not sufficient for the molecule to be optically active. [1+4]
16. Explain the reaction mechanism involved when primary alkyl halide react with alcoholic alkali and aqueous alkali. [5]

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT, BME, BE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

Group A

1. a) Derive Schrodinger wave equation for the wave mechanical model of an atom and write the significance of ψ and ψ^2 . [5]
- b) State Heisenberg uncertainty principle. How this principle goes against Bohr's theory? Explain. [1+3]
2. a) What is de Broglie's equation? Derive a relation between wave length (λ) associated with particle of mass m moving with a velocity V . [1+2]
- b) Calculate the de Broglie wavelength for a ball of 200 gm mass moving with a velocity of 3×10^{10} cm/sec and an electron moving with the same velocity. What these values indicate? [4]
3. a) What is buffer action? Explain clearly why a solution of weak acid and its salt with a strong base behaves as a buffer solution. [1+3]
- b) 100 ml of 1M H_2SO_4 and 50 ml of 2M NaOH are mixed together. Calculate the pH of the resulting solution. [4]
4. a) What is electrochemical series? Write its applications. [4]
- b) Calculate the emf of the cell: $Ni/Ni^{++}(1M) // Pb^{++}(1M) / Pb$ at $25^\circ C$ [4]
 Write down its cell reaction. Standard electrode potential of Ni and Pb are $-0.24V$ and $-0.13V$ respectively at $25^\circ C$.

Group B

5. a) Explain why transition metals (i) show variable oxidation states and (ii) form large number of complexes. [6]
- b) Write down the uses of silicones. [2]
6. a) Write down the conditions necessary for hybridization. Discuss the types of hybridization in SF_6 molecule. [2+4]
- b) Explain the formation of N_2 molecule on the basis of VBT. [2]
7. a) $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$, both are octahedral complexes. What is the difference between the two? Explain on the basis of VBT. [3+3]
- b) Write down the IUPAC names of the following co-ordination compounds (i) $K_3[Co(CN)_5Cl]$ (ii) $[PtCl(NO_2)(NH_3)_2]$ (iii) $[Pt(OH)_4]^{2-}$ (iv) $K_2[HgI_4]$. [2]

OR

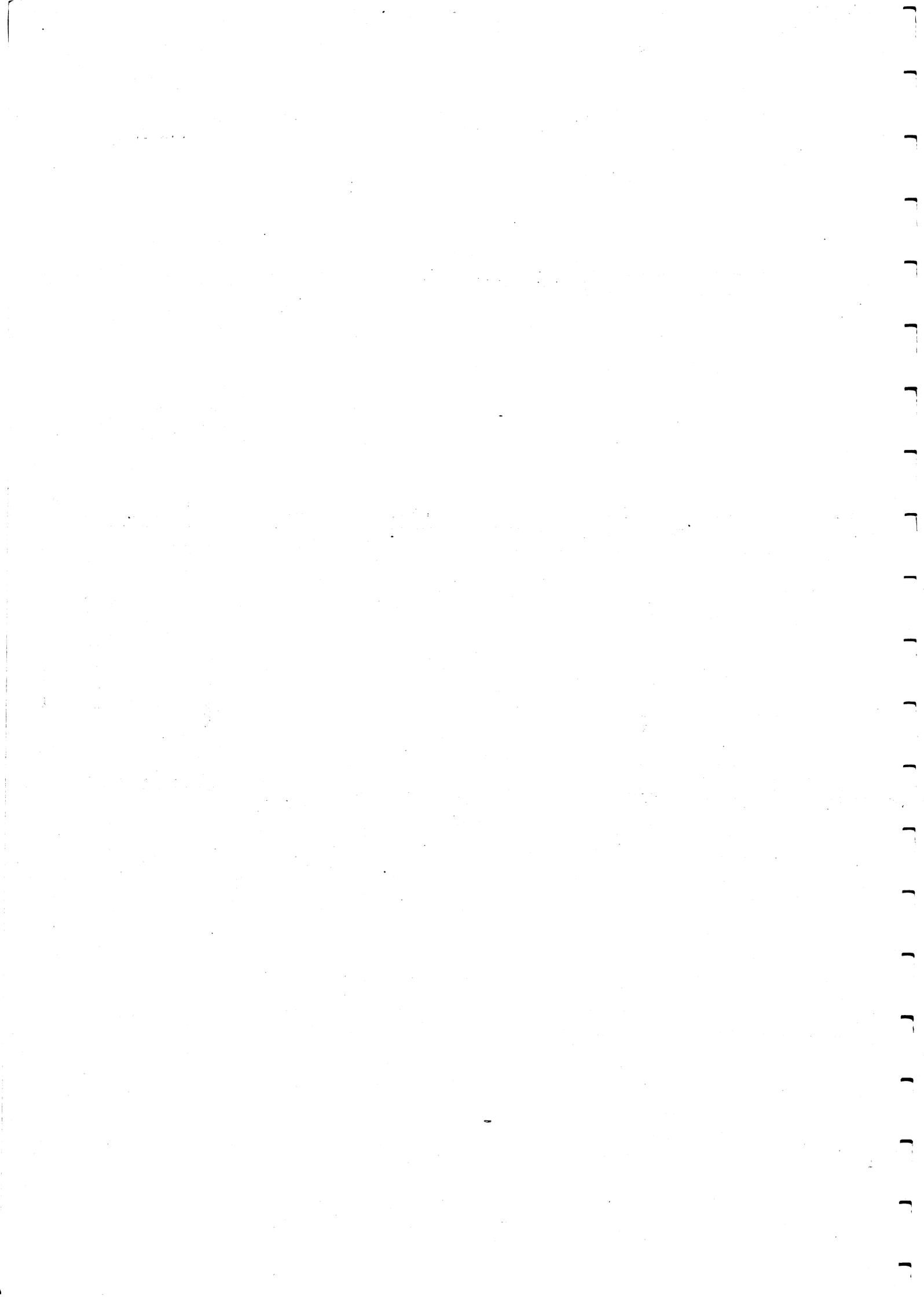
- a) Write down the main postulates of Werner's co-ordination theory. [5]
- b) The formation of inner orbital complexes of Ni^{+2} (CN=6) is not possible. Explain with example. [3]

Group C

8. a) Explain the reaction mechanism of unimolecular elimination reaction with a suitable example. [4]
- b) What does SN^2 and E_2 represents? Write one example of each. [2+2]

OR

- a) Explain the reaction mechanism of bimolecular nucleophilic substitution reaction with a suitable example. [4]
- b) Write E_1 and pinacol pinacolone rearrangement reactions. [2+2]
9. a) Define geometrical and optical isomerisms with suitable examples and write the differences between enantiomers and diastereomers. [3+3]
- b) What happens when toluene is treated with chlorine in different conditions? [2]
10. a) Describe the preparation and uses of Teflon and Nylon 6,6. [3]
- b) What are explosives? Describe the preparation and uses of nitroglycerol. [3]
- c) How can you obtain carboxylic acid and ethanol from Grignard's reagent? [2]



2065 Kartik

Exam. Level	Back	
	BE	Full Marks 80
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks 32
Year / Part	I/ II	Time 3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions selecting at least **Two** from **Group A**, **One** from **Group B** and **One** from **Group C**.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

Group A

1. a) What is meant by 'buffer solution' and 'buffer action'? Explain clearly, why a solution of weak acid and its salt with a strong base behaves as a buffer solution.
b) Explain Sommerfeld's extension of Bohr's atomic model. Calculate the uncertainty in the position of an electron moving with velocity 600 m/s if error in the measurement of velocity is 0.005%. Comment on the result. [8+4+4]
2. a) What is electrochemical corrosion? Explain the mechanism of corrosion and methods of its prevention.
b) 1.64 gm of anhydrous sodium acetate is added to 400 ml of 0.2M acetic acid. What is the pH of buffer? Also calculate the degree of ionization of the acid in the solution. [8+8]
3. a) What do you understand by the terms c_p and c_v ? How are they related with each other? Derive the relationship.
b) What is normal hydrogen electrode? Calculate the emf of the following cell at 25°C. [8+2+6]
 $Zn/Zn^{++} (0.1M) // Ag^+ (1.2M)/Ag$
 $E^\circ Zn/Zn^{++} = +0.76V$
 $E^\circ Ag/Ag^+ = -0.80V$
4. a) What is Aufbau principle? State and explain (n + 1) rule. Write down the configurations of Cu and Cr. Why don't these elements follow Aufbau principle?
b) Define the terms internal energy change and enthalpy change. How are they related? Calculate the work done when one mole of a gas at 25°C and 5 atm. pressure is allowed to expand isothermally but irreversibly against a constant external pressure of 1 atm. until the internal pressure is reduced to 1 atm. [8+4+4]

Group B

5. a) What are the conditions for hybridization? Discuss the type of hybridization that exists in the octahedral shape of molecule with an example.
b) Describe the formation of outer and inner orbital complexes on the basis of valence bond theory. [4+4+8]

6. a) Why one d-block elements known as transition elements? Explain, why transition metals (i) form coloured compounds (ii) show variable oxidation state.
- b) What are cyclic silicones? How are they formed?
7. Explain following giving appropriate reasons. [4×4]
- a) Aqueous solution of $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ gives white ppt with AgNO_3 solution but $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ does not.
- b) CH_4 and H_2O molecules have tetrahedral geometry but their bond angles are different.
- c) PCl_5 exists in nature but NCl_5 does not.
- d) σ bond is stronger than π bond.

Group C

8. Explain the mechanism involved in the following reactions (a) hydrolysis of methyl bromide by aqueous sodium hydroxide. (b) Dehydrohalogenation of tertiary butyl bromide by alcoholic sodium hydroxide. Give reasons. Why (i) Tertiary butyl bromide undergoes SN^1 reaction but methyl bromide undergoes SN^2 reaction. (ii) SN^1 reaction gives both retention and inversion products but SN^2 reaction gives inversion product only. [4+4+4+4]
9. a) Describe the following with examples.
- (i) Enantiomers (ii) Diastereomers (iii) Racemic mixture (iv) Meso compound. Justify the statement "All the diastereoisomers are stereoisomers but all the stereoisomers are not diastereoisomers".
- b) What happens when (i) Glycerol undergoes nitration (ii) Chlorine is passed boiling toluene in presence of uv light. [8+4+4]
10. Write short notes on: [8+8]
- a) Addition polymerization giving preparation of (i) Teflon (ii) Polyester.
- b) Starting from Grignard's reagent, how would you obtain (i) 1° alcohol (ii) 2° alcohol (iii) 3° alcohol (iv) higher alkane. [8+8]

2065 Chaitra

Exam. Level	Regular/Back		
	BE	Full Marks	80
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) Write down the limitation of Bohr's atomic theory. [4]
b) What is energy rule? Calculate of wave length of matter wave of electron. [2+2]
2. a) What is pH scale? Write down the limitation of pH meter. [2+1]
b) Calculate the pH change of buffer solution 100 C.C of semimolar NH_4OH and 400 C.C of $\text{N}/10 \text{ NH}_4\text{Cl}$ in which 20 ml of 0.5 N HCl is added ($K_b = 1.8 \times 10^{-5}$) [5]
3. Give the electro chemical mechanism of corrosion. Calculate the molarity of Fe^{++} ion in the cell when iron electrode is combined with standard AgCl/Ag , Cl^- electrode having emf 0.57V of cell. [4+4]
Given, $E^\circ_{\text{AgCl}, \text{Cl}^-} = +0.22\text{V}$
 $E^\circ_{\text{Fe}/\text{Fe}^{++}} = +0.44\text{V}$
4. Derive Kirchhoff's equation. Calculate the heat of formation of CH_4 gas if enthalpy of combustion of CH_4 gas is -890 KJ , the amount of heat evolved by burning of coke is 394 KJ and standard enthalpy of formation of water is -286 KJ . [4+4]

OR

- Write short notes on: [4+4]
- a) Enthalpy
 - b) Calorific value of food

Group B

5. a) What are co-ordination compounds? Write down the main postulates of Werner's theory. [1+4]
b) How does the valence bond theory explain the formation of tetrahedral complexes? [3]
- OR**
- a) What are the differences between inner orbital and outer orbital complexes? Explain on the basis of valence bond theory the structure of $[\text{FeF}_6]^{3-}$. [2+4]
b) Write down the IUPAC names of the following compounds. [2]
 - i) $[\text{Co}(\text{NH}_3)_4\text{SO}_4]\text{NO}_3$
 - ii) $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$
 - iii) $\text{Na}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$
 - iv) $[\text{Pb}(\text{OH})_4]^{2+}$

6. a) What are transition elements? What do these elements do? [1+2+3]
- form large number of complexes
 - form coloured compounds
- b) Give the four important properties and uses of silicon. [2]
7. a) What are the postulates of valence bond theory of covalent bond? [3]
- b) What is hybridization? How does the shape of octahedral molecules better explained on the basis of hybridization. [1+4]

Group C

8. a) Give an account of stereoisomerism shown by but - 2 - ene - 1, 4 - dioic acid and 2 - hydroxypropanoic acid. [3]
- b) Differentiate between racemic mixture and meso compound. [2]
- c) Write the possible isomers of 2, 3 - dichloropentane and mention enantiomers and diastereomers. [3]
9. a) Explain the SN reaction mechanism. Which occurs both by retention and inversion of configuration. [4]
- b) Describe the mechanism involved in the reaction between tertiary butyl bromide and alcoholic KOH. [4]

OR

- a) Why do SN₁ mechanism occur in two steps? [2]
- b) Why does the attack of nucleophile on tertiary butyl carbonium ion mostly prefer from back side? [2]
- c) Give an account of Pinacol - pinacolone rearrangement and dehydro halogenation of 3 - alkyl halide. [4]
10. a) Write the preparation and uses of polymers formed by the polymerization of tetrafluoro ethylene and vinyl chloride. [4]
- b) What happens when [4]
- Grignard reagent reacts with ethanol
 - Methyl benzene is oxidised by acidic chromyl chloride
 - Toluene is treated with fuming nitric acid
 - n-heptane undergoes aromatisation

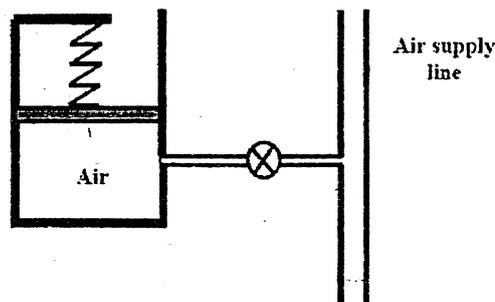
2071 Bhadra

Exam.	Regular / Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

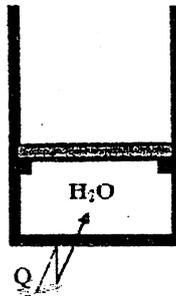
Subject: - Fundamental of Thermodynamics and Heat Transfer (ME452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define atmospheric pressure, gauge pressure and absolute pressure. Also write down the relationship between them. [4]
2. Differentiate between heat transfer and work transfer. [4]
3. Explain saturation curve of two-phase mixture on T-V diagram. [4]
4. Write down general mass conservation and energy conservation equations for a control volume. Also reduce them for a control volume operating under unsteady state condition. [6]
5. Define entropy. Derive expressions for changes in entropy for reversible heat transfer and reversible work transfer processes. [6]
6. Sketch an ideal Brayton cycle on P-v and T-s diagrams. Also derive an expression for its efficiency in terms of pressure ratio. [6]
7. Derive for thermal resistance of composite wall using electric analogy. [6]
8. A 15 kg piston in a cylinder with diameter of 0.15 m is loaded with a linear spring and the outside atmospheric pressure of 100 kPa, as shown in figure below. The spring exerts no force on the piston when it is at the lower position of the cylinder and for the state shown, the pressure is 300 kPa with volume of 0.02 m³. The valve is opened to let some air in, causing the piston to rise 5 cm. Find the new pressure. [Take $g = 9.81 \text{ m/s}^2$] [6]



9. A piston cylinder device shown in figure below contains 2 kg of H_2O with an initial temperature and volume of $80^\circ C$ and $0.05 m^3$ respectively. It requires a pressure of 400 kPa to lift the piston from the stops. The system is heated until its temperature reaches $250^\circ C$. Sketch the process on P-v and T-v diagrams and determine the total work transfer. [Refer attached table for the properties of steam] [8]



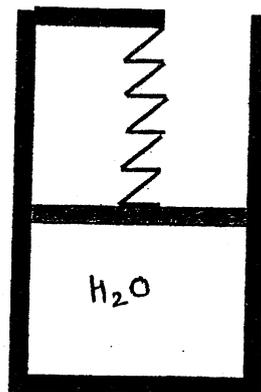
10. Air expands through an adiabatic turbine from 1000 kPa, 1000 K to 100 kPa, 400 K. The inlet velocity is 10 m/s whereas exit velocity is 100 m/s. The power output of the turbine is 3600 kW. Determine the mass flow rate of air and the inlet and exit diameters. [Take $R = 287 J/kgK$ and $C_p = 1005 J/kgK$]. [8]
11. An air conditioning unit with a power input of 1.5 kW. It has a COP of 3 while working as a cooling unit in summer and 4 while working as heating unit in winter. It maintains a hall at $22^\circ C$ year around, which exchanges heat at a rate of 0.8 kW per degree temperature difference with the surroundings. Determine the maximum and the minimum outside temperature for which this unit is sufficient. [8]
12. A Rankine cycle has a boiler working at a pressure of 2 MPa. The maximum and minimum temperatures during the cycle are $400^\circ C$ and $50^\circ C$ respectively. Determine the efficiency of the cycle and compare it with that of the Carnot cycle operating between the same temperature limits. [Refer attached table for the properties of steam] [8]
13. A 2.5 cm thick plate ($k = 50 W/mK$) 50 cm by 75 cm is maintained at $300^\circ C$. Heat is lost from the plate surface by convection and radiation to the ambient air at $20^\circ C$. If the emissivity of the surface is 0.9 and the convection heat transfer coefficient is $20 W/m^2K$, determine the inside plate temperature. [$\sigma = 5.67 \times 10^{-8} W/m^2K^4$] [6]

2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I/II	Time	3 hrs.

Subject: - Fundamental of Thermodynamics & Heat Transfer (ME452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ The figures in the margin indicate Full Marks.
 - ✓ Necessary tables are attached herewith.
 - ✓ Assume suitable data if necessary.
1. Differentiate between intensive and extensive property. State whether the following properties are intensive or extensive volume, specific volume, temperature and pressure. [4]
 2. Differentiate between heat transfer and work transfer. [4]
 3. Define pure substance. Explain with illustration. [4]
 4. Derive the general energy equation for control volume. [6]
 5. Derive the expression for change of entropy for reversible heat reservoirs and reversible work reservoirs. [6]
 6. Differentiate between gas and vapor cycles. Also derive an expression for the air standard efficiency of Otto cycle in terms of compression ratio. [6]
 7. Derive the expression for combined conduction and convection heat transfer through hollow cylinder covered with two layers of insulation. [6]
 8. A gas is contained in a piston cylinder device initially at a pressure of 150 kPa and a volume of 0.04 m^3 . Calculate the work done by the gas when it undergoes the following processes to a final volume of 0.1 m^3 , (i) Constant-Pressure (ii) Constant temperature (iii) $PV^{1.35} = \text{constant}$. [6]
 9. A piston cylinder device with a linear spring initially contains water at a pressure of 4 MPa and 500°C with an initial volume being 0.1 m^3 , as shown in figure. The system now cools until the pressure reaches 1000 kPa. If the piston is at the bottom, the system pressure is 300 kPa. sketch the process on P-v diagram and determine: [8]



- a) The mass of water
- b) The final temperature and volume and
- c) The total work transfer

[Refer the attached tables for properties of steam]

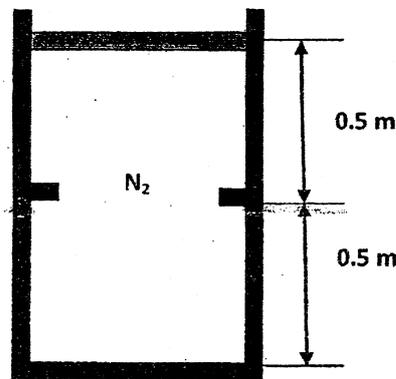
10. Air flows at a rate of 1.5 kg/s through a turbine, entering at 500 kPa, 150° and with a velocity of 120 m/s and leaving at 100 kPa, 25°C and with a velocity of 60 m/s. Power produced by the turbine is 180MW. Determine:

[8]

- a) Heat loss form the turbine and
- b) Diameters of inlet and exhaust pipe

[Take $R = 287 \text{ J/kgk}$, $C_p = 1005 \text{ J/kgk}$]

11. A piston cylinder device shown in figure below contains 1 kg of Nitrogen initially at a pressure of 250 kPa and a temperature of 500°C. Heat is lost from the system till its temperature reaches 40°C. Sketch the pressure on P-V and T-V diagrams and determine the energy generation. Assume that surrounding is at 20°C. Take $P = 297 \text{ J/kgk}$, $C_v = 743 \text{ J/kgk}$.



12. In an air standard Brayton cycle the air enters the compressor at 0.18 MPa, 34°C. The pressure leaving the compressor is 2.3 MPa, and the maximum temperature in the cycle is 2350°C. Determine:

[8]

- a) The pressure and temperature at each point cycle
- b) The compressor work, turbine work, and cycle efficiency

[Take $C_p = 1005 \text{ J/kgk}$, $\gamma = 1.4$]

13. A steam main of 8 cm inside diameter and 9.5 cm outside diameter is lagged with two successive layers of insulation. The layer in contact with pipe is 3.75 cm asbestos with thermal conductivity 0.11 W/m°K and the asbestos layer is covered with 1.5 cm thick magnesia insulation with thermal conductivity of 0.067W/m°K. The inside film heat transfer co-efficient is 290 W/m²K and the outside film heat transfer co-efficient is 7.0 W/m²K. Conductivity of pipe material is 45 W/m°K. Calculate the inside and outside overall heat transfer co-efficient for 50 m length if the steam is passing is at 350°C and the ambient temperature is 30°C.

[6]

Examination Control Division

2070 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Fundamental of Thermodynamic & Heat Transfer (ME452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define thermodynamic equilibrium. Explain with illustrations. [4]
2. Explain the concept of thermodynamic work and differentiate it with mechanical work. [4]
3. Sketch the saturation curve on P-v and T-v diagram with all important points, lines and regions. [4]
4. Derive and explain first law of thermodynamics for a control mass. Also reduce it for a cyclic process. [6]
5. Define entropy. Derive isentropic relations for an ideal gas and an incompressible. [6]
6. Explain the working of simple vapor compression refrigeration cycle with corresponding processes in p-h and T-s diagrams. [6]
7. Derive expressions for inside and outside overall heat transfer co-efficient for a hollow cylinder subjected to convection medium on both sides. [6]
8. 4 kg of air contained in a piston cylinder arrangement at an initial pressure of 2500 kpa and initial volume of 0.25 m³ is allowed to expand according to pressure volume relation of PV³= constant until its volume equals to 0.65 m³. The air is then cooled at constant pressure until the piston comes to its initial position. Then heat is supplied to the air as the piston is locked with a screw until the pressure rises to its initial pressure. Determine the total work transfer. [6]
9. A vessel contains 2 kg of saturated liquid water and saturated water vapor mixture at a temperature of 150°C. One third of the volume is saturated liquid and two third is saturated vapor. Determine the pressure, quality volume internal energy and enthalpy of the mixture. [8]
10. Steam at 4 Mpa, 450°C enters a nozzle operating at steady state with a velocity of 50 m/s. Steam leaves the nozzle at 2 Mpa and 300°C. The inlet area of the nozzle is 80 cm² and heat loss from the nozzle surface occurs at the rate of 100 KW. Determine: [8]
 - i) The mass flow rate of steam
 - ii) The exit velocity of the steam and
 - iii) The exit area of the nozzle

[Refer the attached table for the properties of steam]
11. A control mass system consists of ice and water 12 kg of water, at 37°C is mixed with 8 kg of ice at -27°C. Assuming the process of mixing is adiabatic, find the change of entropy. Latent heat of ice = 336kJ/kg, C_p for water = 4.2 kJ/kg k. [8]
12. A compression ratio of an air standard otto cycle is 8. At the beginning of the compression process, the pressure and temperature of air are 100 kpa and 20°C respectively. The heat added per kg of air during the cycle is 2000 KJ/kg determine: [8]
 - a) The pressure and temperature at the end of each process of the cycle.
 - b) The thermal efficiency. [Take C_v=718 J/kg.k, γ=1.4]
13. An exterior wall of a residential building of 25 cm thick brick [k=0.7 W/m.°C] followed by layers of 2cm thick cement plaster [k=0.48 W/m.°C] on both sides. What thickness of extruded polystyrene insulation [k=0.035 W/m.°C] should be added to reduce the heat loss (or gain) through the wall by 55 percent? [6]

TABLE 1 Properties of SATURATED WATER – Temperature Table

T °C	P kPa	v_f m ³ /kg	v_{fg} m ³ /kg	v_g m ³ /kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg	h_f kJ/kg	h_{fg} kJ/kg	h_g kJ/kg	s_f kJ/kg.K	s_{fg} kJ/kg.K	s_g kJ/kg.K
145	413.29	0.001085	0.4953	0.4964	610.30	1941.5	2554.8	610.35	2129.4	2740.2	1.7910	5.0926	6.8836
150	475.72	0.001090	0.4918	0.4929	631.80	1927.7	2559.7	631.87	2111.1	2746.4	1.8421	4.9960	6.8381
155	542.99	0.001096	0.3457	0.3468	653.35	1910.7	2564.0	653.95	2098.4	2752.3	1.8927	4.9010	6.7937
160	617.66	0.001102	0.3060	0.3071	674.97	1893.3	2568.3	675.65	2082.3	2758.0	1.9429	4.8074	6.7503

TABLE 2 Properties of SATURATED WATER – Pressure Table

P kPa	T °C	v_f m ³ /kg	v_{fg} m ³ /kg	v_g m ³ /kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg	h_f kJ/kg	h_{fg} kJ/kg	h_g kJ/kg	s_f kJ/kg.K	s_{fg} kJ/kg.K	s_g kJ/kg.K
1900	209.33	0.001172	0.4035	0.4047	694.70	1801.0	2598.7	694.72	1900.0	2794.7	2.4921	4.9153	6.4074
2000	212.42	0.001172	0.0984	0.0995	706.3	1691.0	2600.0	706.3	1900.0	2799.0	2.5071	4.8925	6.4096
2250	218.45	0.001185	0.0858	0.0869	728.0	1667.3	2601.3	728.0	1892.3	2800.3	2.508	4.7926	6.2988
3250	238.37	0.001226	0.06027	0.06150	1025.5	1577.7	2603.2	1029.5	1773.6	2803.1	2.6865	3.4673	6.1538
3500	242.60	0.001235	0.05582	0.05705	1045.3	1557.6	2602.9	1049.6	1753.0	2802.6	2.7251	3.3989	6.1240
3750	246.52	0.001244	0.05190	0.05313	1064.2	1538.3	2602.5	1068.3	1733.3	2801.6	2.7616	3.334	6.0957
4000	250.39	0.001252	0.04835	0.04960	1082.2	1519.0	2601.2	1092.3	1713.7	2800.0	2.7962	3.2727	6.0689
5000	266.98	0.001286	0.03815	0.03943	1147.5	1448.7	2586.2	1171.1	1633.9	2785.3	2.9201	3.0524	5.9725

TABLE 3 Properties of SUPERHEATED STEAM

P kPa	T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg.K
2000	(212.42)	(0.09959)	(2599.5)	(2798.7)	(6.3396)
	250	0.1114	2678.8	2901.6	6.5438
	300	0.1254	2771.8	3022.7	6.7651
	350	0.1386	2859.4	3136.6	6.9556
	400	0.1512	2945.1	3247.5	7.1269
	450	0.1635	3010.3	3330.4	7.2735
4000	(250.39)	(0.04977)	(2601.5)	(2800.6)	(6.0689)
	300	0.05882	2724.4	2959.7	6.3598
	350	0.06644	2826.1	3091.8	6.5811
	400	0.07340	2919.8	3213.4	6.7688
	450	0.08002	3010.3	3330.4	6.9364
	500	0.08664	3099.7	3435.4	7.0867
	550	0.09268	3189.0	3533.7	7.2231

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

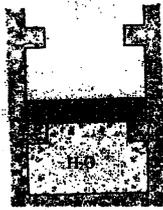
Subject: - Fundamentals of Thermodynamics and Heat Transfer (ME 452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tablees are attached herewith.
- ✓ Assume suitable data if necessary.

1. Differentiate between closed system and open system with suitable examples. [5]
2. Define total energy of a system. And differentiate between the stored energy and transient energy with examples. [4]
3. Sketch saturation curve of water in T-v with the help of isobar lines. Show all important points, lines and region. Also define saturation temperature and quality. [6]
4. Write down general expressions for mass and energy conversion for a control volume. Reduce these equations for an adiabatic nozzle and condenser. [6]
5. Derive expression of entropy generation for a control mass. [6]
6. Write the assumptions of an air standard analysis. Sketch an ideal diesel cycle on P-v and T-s diagrams. Also compare Otto and diesel cycle. [6]
7. Derive an expression for steady state radial heat conduction through a hollow cylinder. Also derive expression for its thermal resistance. [4]
8. A vessel shown has two compartments as shown in figure below at different pressures. The pressure gauge A reads 4 bar and B reads 2 bar. The barometer reads 760mm of Hg. Calculate the reading of gauge C. [Take $\rho = 13600\text{kg/m}^3$ and $g = 9.81\text{m/s}^2$] [5]



9. A one liter closed vessel contains water at its critical conditions. This vessel is cooled until its pressure drops to 1 MPa. Calculate the mass of water in the vessel, the final dryness fraction and final temperature. Also show the process on P-v at T-v diagrams. [6]
10. Consider the piston/cylinder arrangement as shown figure below. When the piston rests on the lower stops, the enclosed volume is 400L. When the piston reaches the upper stops, the volume is 600L. the cylinder initially contains water at 100kPa, 20% quality. It is heated until the water eventually exists as saturated vapor. It takes a pressure of 300kPa to lift the piston. Sketch P-v and T-v diagrams and determine the work transfer and heat transfer for the overall process. [8]



11. The conditions of steam at entrance and exit of a turbine are: $h_1 = 3456.5 \text{ kJ/kg}$, $S_1 = 7.2338 \text{ kJ/kgK}$, $V_1 = 150 \text{ m/s}$; and $h_2 = 2792.8 \text{ kJ/kg}$, $S_2 = 7.4665 \text{ kJ/kgK}$, $V_2 = 100 \text{ m/s}$ respectively. The work output per kg of steam flow is 600 kJ . Heat transfer between of 500 K . Determine the entropy generation per kg steam flow. [8]
12. Air is used as the working fluid in a simple ideal Brayton cycle that has a pressure ratio of 12, a compressor inlet temperature of 300 K , and a turbine inlet temperature of 1000 K . Determine the required mass flow rate of air for a net power output of 90 MW also calculate thermal efficiency of the cycle. [8]
13. An exterior wall of a house consists of 10 cm of common brick ($k = 0.8 \text{ W/mK}$) followed by a 4 cm layer of gypsum plaster ($k = 0.5 \text{ W/mK}$). What thickness of rock wool insulation ($k = 0.065 \text{ W/mK}$) should be added to reduce the heat transfer through the wall by 50% ? [8]

2068 Bhadra

Exam. Level	Regular		
	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

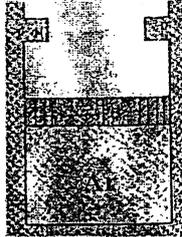
1. Differentiate between microscopic and macroscopic view point of thermodynamics. [4]
2. Write down the similarities and differences between heat transfer and work transfer. [4]
3. Define pure substance. State and explain 'State Postulate'. [4]
4. Write down general mass conservation and energy conservation equations for a control volume. Also derive mass and energy conservation equations for a gas filling process in a gas station. [6]
5. Write down classical statements of second law of thermodynamics. Derive the equivalence between Kelvin Plank's and Clausius's statement of 2nd law of thermodynamics. [6]
6. What is air standard cycle? Differentiate between diesel cycle and otto cycle. [6]
7. Derive the heat transfer for composite plane wall. State the electrical analogy for thermal resistance. [6]
8. A piston cylinder device loaded with a linear spring with a spring constant of $k = 100\text{kN/m}$ contains a gas initially at a pressure of $P_{\text{atm}} = 100\text{ kPa}$ and a volume of 0.05m^3 , as shown in figure below. The mass and cross sectional area of the piston are 50 kg and 0.01m^2 respectively. Heat is supplied to the system until its volume doubles, determine the final pressure. [Take $g = 9.81\text{m/s}^2$] [6]



9. A rigid vessel having a volume of 0.02m^3 , initially contains water at its critical state. The vessel is cooled until its pressure drops to 2000kPa . Sketch the process on P-V and T-V diagrams and determine: [6]
 - a) The mass of H_2O present in the vessel
 - b) The quality at final state
 - c) The mass of saturated liquid water and saturated water vapour at the final state. [Refer attached table for the properties of steam].

10. Argon (100g) is in the piston-cylinder device shown in the figure below. The initial pressure is 6.0 MPa and temperature is 200°C. There is a heat transfer to the argon, causing the piston to rise until it hits the stops. There is an additional heat transfer until the final pressure is 8.0 MPa and temperature is 800°C. [3]

- a) Draw the process on P-V and T-V diagrams
- b) Find the total work done in the process [$c_p = 208 \text{ J/kgK}$].



11. A heat pump having a coefficient of 50% of the theoretical maximum maintains a house at a temperature of 20°C. The heat leakage from the house occurs at a rate of 0.8 kW per degree temperature difference. For a maximum power input of 1.5 kW, determine the minimum surroundings temperature for which the heat pump will be sufficient? [8]

12. A steam power plant operates on a simple Rankine cycle between the pressure limits of 2 MPa and 20 kPa. The temperature of the steam at the turbine inlet is 400°C, and the mass flow rate of steam is 50 kg/s. Determine: [8]

- a) The thermal efficiency of the cycle
- b) The net power output of the plant [Refer attached table for the properties of steam]

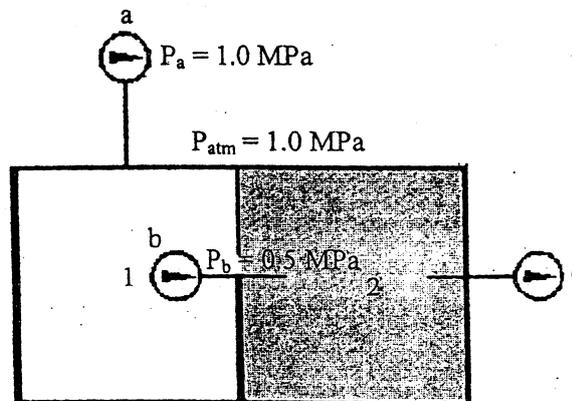
13. The inside surface of an insulating layer is at 300°C and the outside surface is dissipating heat by convection into air at 25°C. The insulating layer has a thickness of 5 cm and thermal conductivity of 0.8 W/mK. What is the minimum heat transfer coefficient at the outside surface if the outside surface temperature should not exceed 100°C? [8]

Exam. Level	Regular / Back		
	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary charts are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define thermodynamic process. Sketch P-v, T-v and P-T diagram for an ideal gas undergoing isothermal expansion. [5]
2. Define work transfer and heat transfer. Also mention their sign conventions used in the analysis of thermodynamic problems. [4]
3. Define: saturation temperature, saturated vapor, quality, subcooled liquid and critical point. [5]
4. Define steady and unsteady state system. Derive the expression of conservation of mass and conservation of energy for control volume having steady and unsteady flow. [6]
5. Define reversible heat transfer reservoir and reversible work transfer reservoir. Derive expressions for change in entropy for reversible heat transfer reservoir and reversible work transfer reservoir. [8]
6. Differentiate between power cycle and refrigeration cycle. Sketch components, P-v and T-s diagrams for Rankine cycle. [6]
7. Define thermal resistance. Write down expressions of thermal resistance for plane wall, hollow cylinder and convection heat transfer. Derive an expression of heat transfer for a composite plane wall consisting of three layers using thermal resistance, inside and outside wall temperature. [6]
8. Attached to the containers shown in figure below are three pressure gauges. Determine the absolute pressure in compartment 2 and reading of pressure gauge c. [5]



9. A rigid container with a volume of 0.170m^3 is initially filled with steam at 200 kPa and 350°C . It is cooled to 90°C .

[7]

- a) At what temperature does a phase change starts to occur?
- b) What is the final pressure?
- c) What mass fraction of the water is liquid in the final state?

Also sketch the process on P-v and T-v diagrams. [Refer the attached table for properties of steam]

10. An adiabatic diffuser has air entering at 100kPa, 300K, with a velocity of 200m/s. The inlet cross sectional area of the diffuser is 100mm^2 . At the exit, the area is 860mm^2 , and the exit velocity is 20m/s. Determine the exit temperature and pressure of the air. [Take $C_p = 1005\text{ J/kg K}$, $R = 287\text{J/kg K}$].

[8]

11. Steam at 700kPa with a quality of 0.96, is throttled down to 350kPa. Calculate the change of entropy per unit mass of steam. [Refer the attached table for properties of steam.]

[6]

12. Air enters the compressor of an ideal air standard Brayton cycle at 100kPa, 300K, with a volumetric flow rate of $5\text{m}^3/\text{s}$. The compressor pressure ratio is 10. The turbine inlet temperature is 1400K. Determine:

[8]

- a) The thermal efficiency of the cycle
- b) The net power developed, in kW. [Take $R = 287\text{J/kg K}$, $c_p = 1005\text{J/kg K}$, $\gamma = 1.4$]

13. The inside surface of an insulating layer is at 270°C , and the outside surface is dissipating heat by convection in to air at 20°C . The insulation layer is 4 cm thick and has thermal conductivity of 1.2W/m.K . What is the minimum value of the heat transfer coefficient at the outside surface if the outside temperature is not to exceed 70°C ?

[6]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Thermodynamics and Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define quality of a two-phase mixture. Water at atmospheric condition is heated to superheated vapor state under constant pressure condition. Sketch the heating process on P-v, T-v and T-s diagrams. [5]
2. Prove that "There exists a property of a closed system such that a change in its value is equal to the difference between the heat supplied and the work done during any change of state." [6]
3. Write down classical statements of second law of thermodynamics. [3]
4. Sketch P-V and T-S diagrams for air standard Otto and air standard Diesel cycle. List the differences between Otto and Diesel cycle. [5]
5. Define thermal resistance. Write down expressions for thermal resistances for plane wall, hollow cylinder and convection heat transfer. Derive an expression for a composite plane wall consisting of three layers using thermal resistance. [6]
6. Define viscosity. Explain the effect of temperature and pressure on viscosity. [4]
7. Differentiate between Laminar and turbulent flow. Also define Reynolds Number. [5]
8. Define turbine. How turbines are classified according to head? [4]
9. Air (2 kg) is contained in a vertical frictionless piston-cylinder device shown in *Figure P.9*. The mass of the piston is such that the air has a pressure and temperature of 10.0 MPa and 75.5°C. There is a heat transfer to the cylinder until the piston reaches some stops, at which point the total volume is 0.04 m³. There is an additional heat transfer to the air until the pressure is 15.0 MPa. Determine the total heat transfer and the total work, and show the process on P-v and T-v diagrams. [$R = 287 \text{ J/kg.K}$, $c_v = 718 \text{ J/kg.K}$] [10]

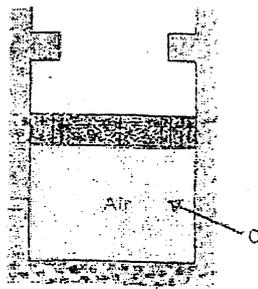


Figure P.9

10. Steam at 800 kPa and 300°C is flowing with a velocity of 45 m/s reversibly and adiabatically through a nozzle and leaves the nozzle at 100 kPa. Determine the exit velocity of the steam in m/s. [Refer the attached table for properties of steam] [8]

11. An air-standard Diesel cycle has a compression ratio of 18, and the heat transferred to the working fluid per cycle is 1800 kJ/kg. At the beginning of the compression process the pressure is 0.1 MPa and the temperature is 15°C. Determine:

- (a) The pressure and temperature at each point in the cycle.
- (b) The thermal efficiency.
- (c) The mean effective pressure.

[Take $c_p = 1.005 \text{ kJ/kg}$ and $c_v = 0.718 \text{ kJ/kg}$].

[10]

12. An insulated steam pipe passes through a room in which the air and walls are at 25°C. The outside diameter of the pipe is 70 mm, and its surface temperature and emissivity are 200°C and 0.8 respectively. If the coefficient associated with free convection heat transfer from the surface to the air is 15 W/m²K, what is the rate of heat loss from the surface per unit length of the pipe? [$\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$]

[7]

13. Water is flowing at the rate of 40 liters/s through a tapering pipe. The diameters at the bottom and upper ends are 300 mm and 200 mm respectively. If the pressure at the bottom and upper ends are 250 kPa and 100 kPa respectively determine the difference in datum head. [$\rho = 1000 \text{ kg/m}^3$, $g = 9.81 \text{ m/s}^2$]

[7]

TABLE 1 Properties of SATURATED WATER – Pressure Table

P kPa	T °C	v_l m ³ /kg	v_{lg} m ³ /kg	v_g m ³ /kg	u_l kJ/kg	u_{lg} kJ/kg	u_g kJ/kg	h_l kJ/kg	h_{lg} kJ/kg	h_g kJ/kg	s_l kJ/kg.K	s_{lg} kJ/kg.K	s_g kJ/kg
90	95.713	0.001041	1.8688	1.8698	405.11	2097.1	2502.2	405.20	2265.3	2670.5	1.2696	6.1247	7.398
100	99.632	0.001043	1.6933	1.6943	417.41	2088.3	2505.7	417.51	2257.6	2675.1	1.3027	6.0562	7.358
101.32	100.00	0.001043	1.6727	1.6737	418.96	2087.1	2506.1	419.06	2256.6	2675.7	1.3069	6.0476	7.354
200	119.93	0.001108	1.2177	1.2178	466.58	1875.8	2572.4	467.55	2066.0	2768.3	1.9925	4.7184	6.707
250	117.79	0.001111	1.2542	1.2555	478.76	1868.8	2574.6	479.59	2058.6	2766.2	2.0203	4.6642	6.684
300	117.44	0.001115	1.2893	1.2904	490.83	1866.8	2576.6	491.28	2049.7	2768.9	2.0464	4.6161	6.662
350	117.97	0.001118	1.2258	1.2269	502.87	1866.1	2578.5	503.32	2039.4	2771.1	2.0712	4.5706	6.641

TABLE 2 Properties of SUPERHEATED STEAM

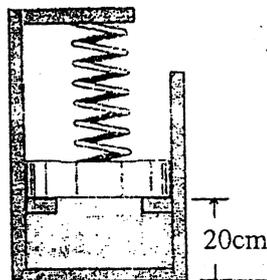
P kPa	T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg.K
800	(170.44)	(0.2404)	(2576.6)	(2768.9)	(6.6625)
	200	0.2607	2630.2	2838.8	6.8151
	250	0.2931	2714.8	2949.3	7.0373
	300	0.3241	2796.6	3055.9	7.2319
	350	0.3544	2877.9	3161.4	7.4034
	400	0.3843	2959.6	3267.0	7.5713
	450	0.4139	3042.2	3373.3	7.7237
	500	0.4433	3126.1	3480.7	7.8673
	550	0.4726	3211.5	3589.4	8.0036

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BEX, BCT	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Thermodynamics and Heat Transfer

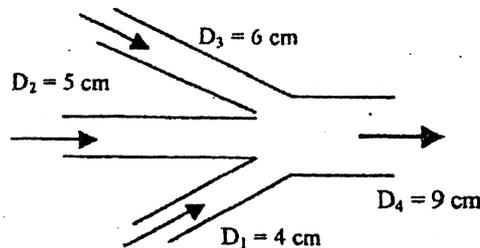
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Sketch the following process on P-v, T-v and T-s diagrams: [5]
 - a) Water at compressed liquid state is heated to super heated vapor state in a cylinder with a freely moving cylinder.
 - b) Water at two phase mixture (saturated liquid and saturated vapor) state is heated to super heated vapor state in a rigid vessel.
2. Define total energy of a system. Also differentiate between the stored energy and transient energy. [5]
3. Define steady state work applications. Write down the steady state energy equation and reduce it for an adiabatic turbine. Explain which properties are significant for a gas turbine. [5]
4. Define a polytropic process. Sketch polytropic processes with $n = 0, 1, 1.4$ and ∞ on a common P-v diagram. Derive an expression for work transfer for an isothermal process. [5]
5. Air ($m = 0.1$ kg) is contained in piston/cylinder assembly as shown in figure. Initially, the piston rests on the stops and is in contact with the spring, which is in its unstretched position. The spring constant is 100 kN/m. The piston weighs 30 kN and atmospheric pressure is 101 kPa. The air is initially at 300K and 200 kPa. Heat transfer occurs until the air temperature reaches the surrounding temperature, 700K. [10]
 - a). Find the final pressure and volume
 - b) Find the process work
 - c) Find the heat transfer
 - d) Draw the P-V diagram of the process. [Take $R = 287$ J/kgK, $C_v = 718$ J/kg K]



6. Steam enters a nozzle at 400°C and 800 kPa with a velocity of 10 m/s, and leaves at 300°C and 200 kPa while losing heat at a rate of 25 kW. For an inlet area of 800cm², determine the velocity and the volume flow rate of the steam at the nozzle exit. [Refer the attached table for properties of steam] [8]

7. State Clausius Inequality. Write it for reversible and irreversible refrigerators. [5]
8. The pressure and temperature at the beginning of compression of an air-standard diesel cycle are 95 kPa and 300K, respectively. At the end of the heat addition, the pressure is 7.2 MPa and the temperature is 2150K. Determine: [10]
- the compression ratio
 - the cutoff ratio
 - the thermal efficiency of the cycle. [$R = 287 \text{ J/kg}$, $C_v = 718 \text{ J/kg K}$]
9. Derive an expression for an overall heat transfer coefficient for a composite cylinder consisting of three cylindrical layers subjected to convection on both sides. [5]
10. The roof of an electrically heated home is 8m long, 6m wide, and 0.25m thick, and is made of a flat layer of concrete whose thermal conductivity is $k = 0.8 \text{ W/m.K}$. The temperatures of the inner and the outer surfaces of the roof on night are measured to be 15°C and 4°C , respectively, for a period of 10 hours. Determine: [6]
- the rate of heat loss through the roof for that night, and
 - the cost of that heat loss to the home owner if the cost of electricity is Rs. 10/kWh.
11. Define: Cohesive force, Pressure head, Stream line and Coefficient of Lift. [5]
12. Three pipes steadily deliver water to a large exit pipe shown in figure. For velocity $V_2 = 5 \text{ m/s}$, and the exit flow rate $Q_4 = 120 \text{ m}^3/\text{h}$, find (a) V_1 ; (b) V_3 ; and (c) V_4 if it is known that increasing Q_3 by 20% would increase Q_4 by 10%. [6]



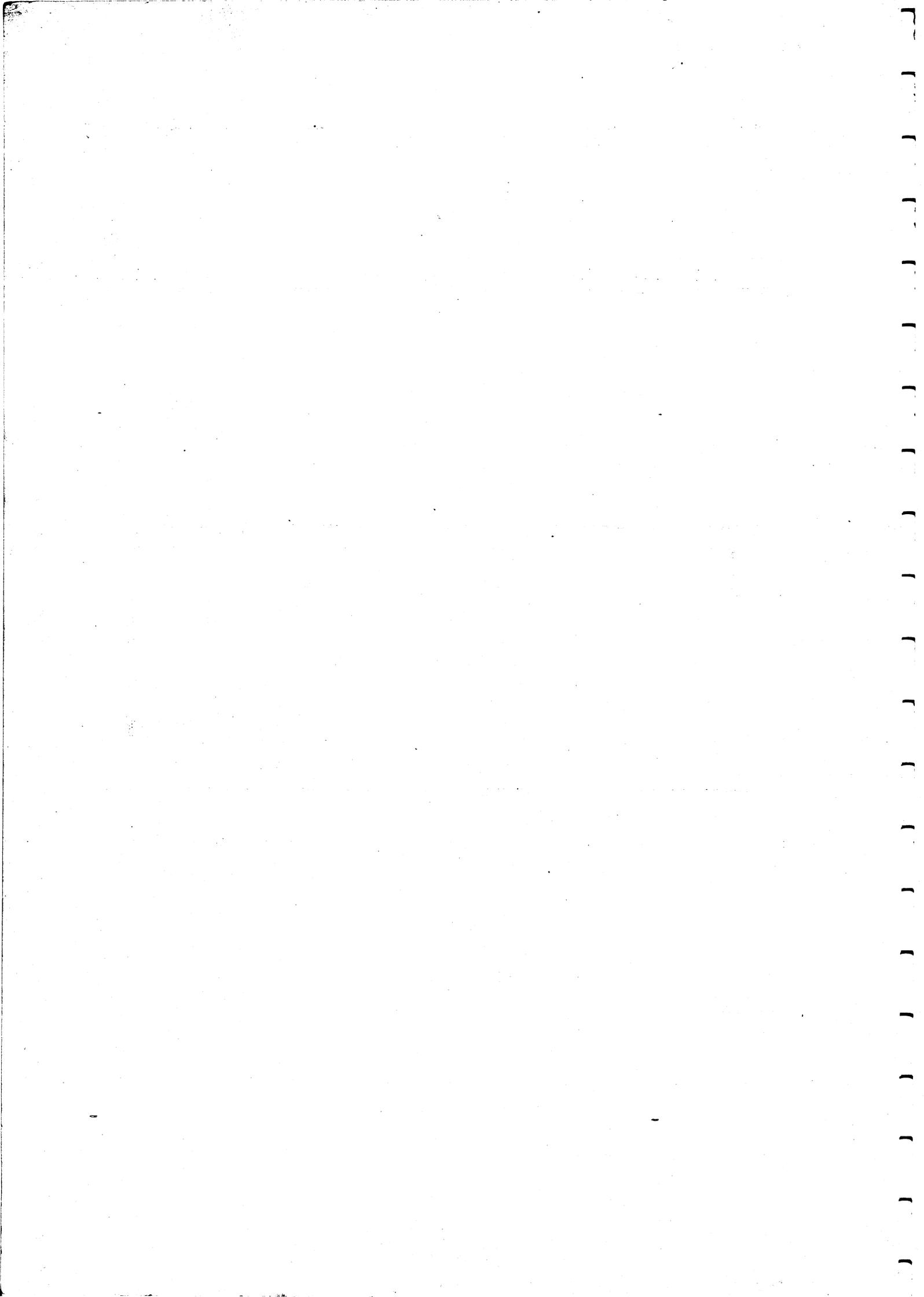
13. Define turbomachine and hydraulic machine. Differentiate between turbine and pump. [5]

Exam. Level	Back		
	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Thermodynamics and Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the laws of thermodynamics. Define the entropy as a function of state. [5]
2. a) Write down the general steady flow energy equation. Derive the simplified forms when used for the centrifugal pump and table fan. [5]
- b) Water is in a piston/cylinder maintaining constant pressure at 700 KPa, quality 90% with a volume of 0.1m^3 . A heater is turned on, heating the water with 2.5 KW. How long does it take to vaporize all the liquid? [8]
3. a) Define heat engine, refrigerator and heat pump. Explain why the performance of heat engine is measured in terms of efficiency but that of refrigerator and heat pump is in terms of COP? Why does the expression for COP differ for refrigerator and heat pump? [5]
- b) A Carnot engine operates between two reservoirs at temperature T_L and T_H . The work output of the engine is 0.6 times the heat rejected. The difference in temperatures between the source and the sink is 200°C . Calculate the thermal efficiency, the source temperature and the sink temperature. [6]
4. a) Using T-S and P-V diagram, prove that, for the same quantity of heat added, increase of compression ratio increases the thermal efficiency of an Otto-Cycle. [8]
- b) Consider a steam power plant operating on the simple ideal Rankine Cycle. The steam enters the turbine at 3 Mpa and 350°C and is condensed in the condenser at a pressure 80 Kpa. Determine the thermal efficiency of the cycle. [8]
5. a) Derive an expression for the heat loss and overall heat transfer coefficient through a composite wall of layers considering the convective heat transfer coefficient. [8]
- b) Air at 27°C and 1 atm flows over a flat plate at a temperature of 60°C with a speed of 2 m/s. Calculate the heat transferred in the first 20cm of the plate and 40cm of the plate. (Properties at the film temperature 43.5°C are $\nu = 17.36 \times 10^{-6}\text{m}^2/\text{s}$, $K = 0.02749\text{ W/m}^\circ\text{C}$, $Pr = 0.7$, $C_p = 1.006\text{ KJ/Kgk}$) [8]
6. a) Explain the characteristics of laminar and turbulent boundary layer. [5]
- b) The diameter of a pipe changes from 200mm at a section of 5m above datum to 50mm at a section 3m above datum. The pressure of water at first section is 500 Kpa. If the velocity of flow at the first section is 1m/s, determine the pressure at the second section. [8]
7. Describe the working principles of impulse and reaction turbine. [6]

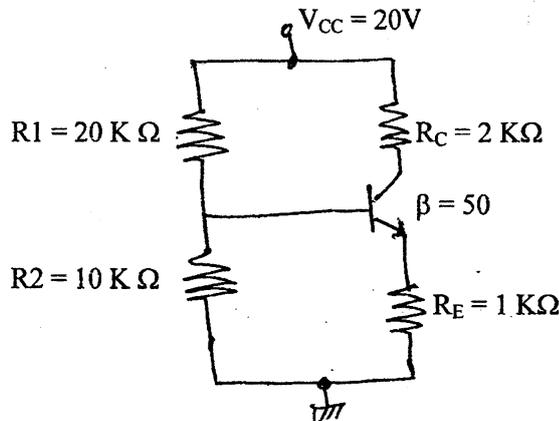


Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B. Arch)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Basic Electronics Engineering (EX451)

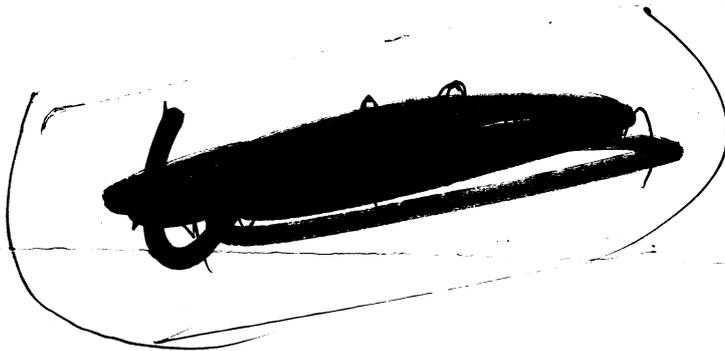
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What do you mean by filter? Explain the operation of RC high pass filter. (2) [1+3]
- b) Define dependent voltage source and transconductance with diagrams. [2+2]
2. A silicon junction PN junction diode with $n = 1$ has voltage drop 0.7 V at current of 1 mA. Find the voltage drop at current equal to 0.1 mA. [3]
3. Draw full wave bridge rectifier circuit and explain its operation. Express its equivalent average dc voltage output. (5) [5+1]
4. Draw symbol for tunnel diode and its IV-characteristic graph. (3) (5) [1+2]
5. Find the values of I_{CQ} and V_{CEQ} for the given circuit. Given data are:
 $V_{CC} = +20V, \beta = 50.$ [5]



6. Draw circuit diagram to study the dc output IV-characteristics of Enhancement type MOSFET and explain its output IV-characteristic graph. (2) [5]
7. Explain the concept of virtual short in ideal operational amplifier. (2) [2]
8. Deduce the output voltage for integrating amplifier and non inverting amplifier. [4]
9. State Barkhausen criteria. Draw Wien bridge oscillator circuit and express its frequency of oscillation. [1+3]
10. What is wireless communication? Draw block diagram of communication system and explain each block. (6) [2+5]
11. What is electromagnetic wave (EMW)? Explain EMW propagation. (3) [3]

- 12. Explain the operation of D-flipflop with preset and reset facilities with necessary diagram and truth table. [5]
- 13. Subtract $(15)_{10}$ from $(10)_{10}$ using 2's complement method. [2]
- 14. What is counter? Explain with diagram the 3-bit asynchronous counter. [5]
- 15. Draw block diagram of digital voltmeter. And explain how it measures dc voltage. (4) [5]
- 16. Describe active and passive transducers. (2) [4]
- 17. Write short notes on: (any three) [3×3]
 - i) Photo diode (1)
 - ii) BJT as switch (3)
 - iii) Differential amplifier (3)
 - iv) Duality Theorem

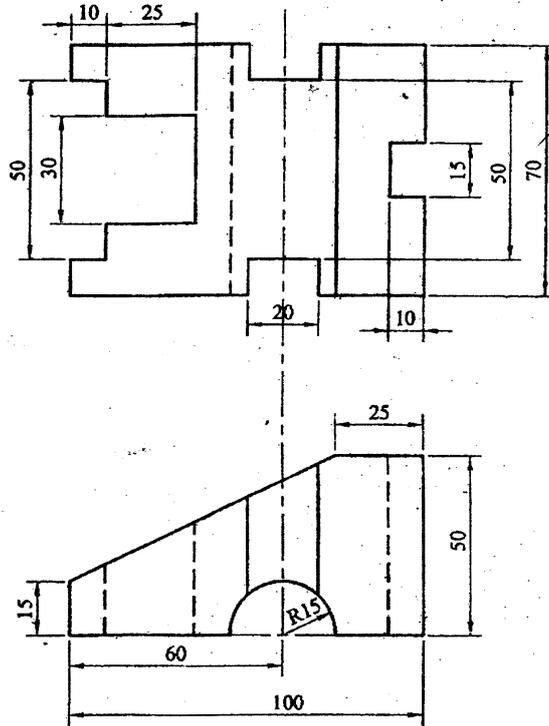


Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B. Arch)	Pass Marks	16
Year / Part	I / II	Time	3 hrs.

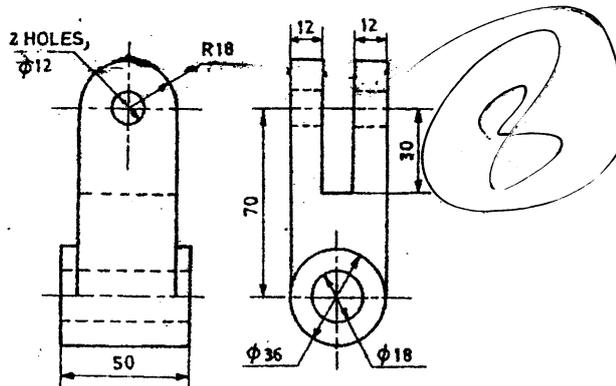
Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Orthographic views of an object is shown in figure below. Draw its Isometric view. [10]



2. Draw oblique view of an object from given orthographic views in figure below. [6]



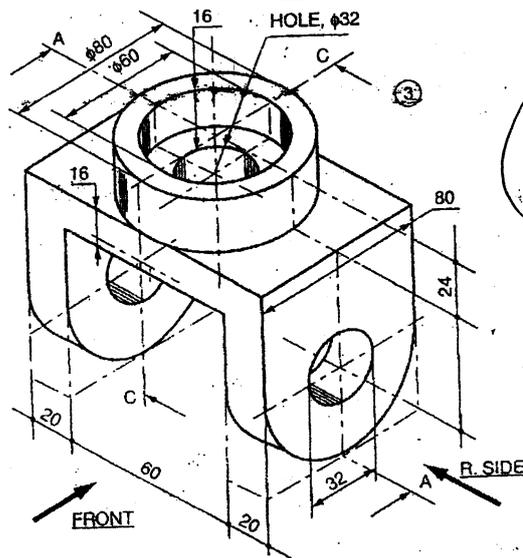
3. Draw the top view and sectional front view of double riveted chain type lap joint for basic diameter of hole is 24 mm. [5]

OR

Determine the maximum and minimum material conditions, allowance and type of fit for hole and shaft designated by H7/s6 for the basic size of 50 mm. Assuming fundamental deviation for H and s are 0 mm and 0.040 mm respectively and values of international tolerance grades for 7 and 6 are 0.025 mm and 0.016 mm respectively.

4. Draw sectional front view (section at A-A) from the components as shown in figure below.

[5]



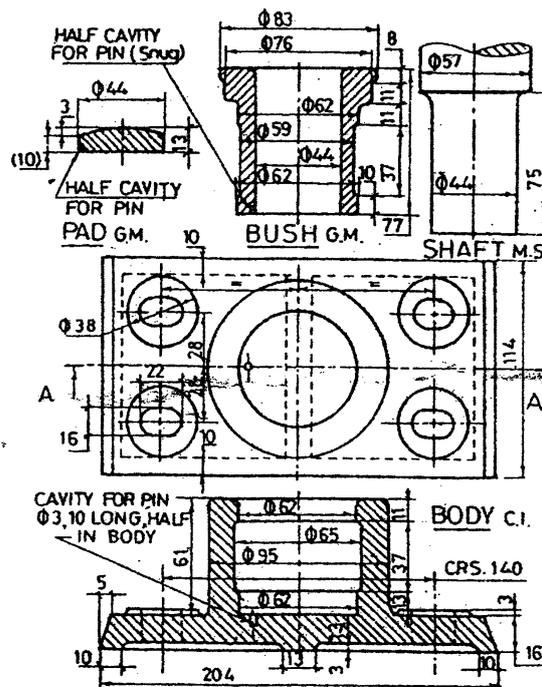
OR

Sketch the symbols for the following

- | | |
|----------------------|------------------------------------|
| a) Spot weld | f) Circuit breaker |
| b) Crossover | g) Public addressing system |
| c) Three phase motor | h) Surface finish with X roughness |
| d) Embankment | i) Amplifier |
| e) Nipple | j) Hill contour |

5. Assemble the parts shown in figure below of foot-step bearing and draw half-section front view of assembled product. Dimension as the requirement.

[14]



Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Chemistry (SH453)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is meant by standard hydrogen electrode? Explain briefly with diagram. Calculate the emf of the following cell at 25°C Mg/Mg⁺⁺ (0.1M)//Ag⁺(1M)/Ag. Given E°Mg⁺⁺/Mg = -2.37 V E°Ag⁺/Ag = +0.80V [3+2]
2. a) What is meant by buffer capacity of a buffer solution? How does a solution containing a mixture of benzoic acid and sodium benzoate maintain its constant pH value even on the addition of small amount of strong acid or alkali? Explain. [3]
- b) Derive Henderson's equation for basic buffer solution. [2]
3. Show your acquaintance to homogenous and heterogeneous catalysis. Describe the intermediate compound formation theory of catalysis. [2+3]
4. a) What are the main sources of water pollution? Write the various impacts of water pollution. [3]
- b) What are the causes of soil pollution? How it can be controlled? [2]
5. What are air pollutants? Give a brief account about the adverse effects of air pollutants on human beings and their possible remedies. [2+1.5+1.5]
6. What do you meant by cross linked polymer? What are the general characteristics of inorganic polymer? What are the engineering application of chalcogenide polymer? [1+2+2]
7. a) What are fiber reinforced polymers? Write their application in the field of engineering. [3]
- b) What are non-biodegradable polymers? What are the demerits of using them? [2]
8. a) Are all d-block elements called transition elements? Justify your answer with reason. Why do transition elements called so? [2]
- b) Why do transition elements show variable oxidation state? Point out the industrial applications of 3d-series elements. [3]
9. Explain why: [2.5×2]
 - a) Compounds of Titanium in +3 oxidation state are coloured but those in +4 oxidation state are colourless.
 - b) Transition elements formed significant number of complexes.
10. How would you account for the difference in structures and magnetic properties between [Ni(Cl₄)²⁻ and [Ni(CN)₄]²⁻? [2.5×2]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer (ME452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Differentiate between Microscopic and Macroscopic viewpoint with examples. [4]
2. Derive expressions for displacement work transfer for the following process: [4]
 - a) Constant- Pressure Process
 - b) Constant temperature process and
 - c) Polytrophic process
3. Explain how saturation curve is formed on T-v diagram. [4]
4. State first law of thermodynamics for a control mass undergoing cyclic process. Write the mass and energy equations for a control volume and reduce them for steady state process. [6]
5. Define isentropic process. Derive isentropic relations for an ideal gas and incompressible substances. [6]
6. Sketch an ideal Brayton cycle on P-v and T-s diagrams; also derive an expression for its efficiency. [6]
7. Derive an expression for conduction heat transfer through a composite cylinder. [6]
8. A mercury manometer is used to measure the pressure in stream pipe. The level of the mercury in the manometer is 97.5 mm. Find the absolute pressure of stream inside the pipe. If the reading of the manometer drops to 80 mm, what is the new pressure of steam? [6]

[Take sp.gr. of Hg = 13.6, $P_{atm} = 760$ mm of Hg and $g = 9.81$ m/s²]
9. A rigid container with a volume of 0.170 m³ is initially filled with steam at 200 kPa, 300°C. It is cooled to 90°C. (Steam tables are attached here with) [8]
 - a) At what temperature does a phase change start to occur?
 - b) What is the final pressure?
 - c) What mass fraction of the water is liquid in the final state?
10. A gas turbine develops 60 MW of power output, Mass flow rate of gas is found to be 80 kg/s. Properties of gas at inlet and exit of the turbine are as follows: [8]

Properties	Inlet	Outlet
Pressure	8 MPa	0.1 MPa
Temperature	500°C	50°C
Velocity	50 m/s	150 m/s
Elevation above the reference level	10 m	5 m

- a) Determine the rate at which heat is lost from the turbine surface.
- b) Determine the inlet and outlet areas. [Take $R = 287$ J/kg.k $C_p = 1005$ J/kgk]

Table A 2.2: Properties of SATURATED WATER – Temperature Table

T °C	P kPa	v_l m ³ /kg	v_{lg} m ³ /kg	v_g m ³ /kg	u_l kJ/kg	u_{lg} kJ/kg	u_g kJ/kg	h_l kJ/kg	h_{lg} kJ/kg	h_g kJ/kg	s_l kJ/kg.K	s_{lg} kJ/kg.K	s_g kJ/kg.K
5	0.8726	0.001000	147.02	147.02	21.020	2360.4	2381.4	21.021	2488.7	2509.7	0.07626	8.9473	9.0236
10	1.2281	0.001000	106.32	106.32	41.986	2346.3	2388.3	41.988	2476.9	2518.9	0.1510	8.7476	8.8986
15	1.7056	0.001001	77.896	77.897	62.915	2332.3	2395.2	62.917	2465.1	2528.0	0.2242	8.5550	8.7792
20	2.3388	0.001002	57.777	57.778	83.833	2318.2	2402.0	83.835	2453.4	2537.2	0.2962	8.3689	8.6651
25	3.1690	0.001003	43.356	43.357	104.75	2304.1	2408.9	104.75	2441.6	2546.3	0.3670	8.1888	8.5558
30	4.2453	0.001004	32.896	32.896	125.67	2290.0	2415.7	125.67	2429.6	2555.5	0.4365	8.0248	8.4513
35	5.6216	0.001006	25.219	25.220	146.58	2275.9	2422.5	146.59	2417.8	2564.2	0.5050	7.8461	8.3561
40	7.3814	0.001008	19.527	19.528	167.50	2261.7	2429.2	167.50	2405.9	2573.2	0.5723	7.6827	8.2550
45	9.5393	0.001010	15.262	15.263	188.41	2247.5	2435.9	188.42	2393.9	2582.3	0.6385	7.5344	8.1629
50	12.344	0.001012	12.036	12.037	209.31	2233.3	2442.6	209.33	2381.9	2591.2	0.7037	7.4008	8.0745
55	15.752	0.001015	9.5716	9.5726	230.22	2219.0	2449.2	230.24	2369.8	2600.0	0.7679	7.2217	7.9896
60	19.932	0.001017	7.6733	7.6743	251.13	2204.7	2455.8	251.15	2357.7	2608.8	0.8312	7.0768	7.9080
65	25.022	0.001020	6.1986	6.1996	272.05	2190.3	2462.4	272.08	2345.4	2617.5	0.8935	6.9360	7.8295
70	31.176	0.001023	5.0437	5.0447	292.98	2175.8	2468.8	292.91	2333.1	2626.1	0.9549	6.7991	7.7540
75	38.563	0.001026	4.1323	4.1333	313.92	2161.3	2475.2	313.96	2320.6	2634.6	1.0155	6.6658	7.6813
80	47.373	0.001029	3.4078	3.4088	334.83	2146.7	2481.6	334.93	2308.2	2643.1	1.0753	6.5359	7.6112
85	57.815	0.001032	2.8279	2.8289	355.76	2132.0	2487.9	355.92	2295.8	2651.4	1.1340	6.4093	7.5436
90	70.117	0.001036	2.3607	2.3617	376.86	2117.1	2494.0	376.98	2282.7	2659.6	1.1925	6.2859	7.4782
95	84.529	0.001040	1.9818	1.9828	397.89	2102.2	2500.1	397.98	2269.7	2667.7	1.2491	6.1653	7.4154
100	101.32	0.001043	1.6726	1.6736	418.96	2087.4	2506.1	419.06	2256.6	2675.7	1.3069	6.0476	7.3545
105	120.79	0.001047	1.4190	1.4200	440.05	2072.1	2512.1	440.18	2243.4	2683.6	1.3630	5.9326	7.2956
110	143.24	0.001052	1.2095	1.2106	461.19	2056.7	2517.9	461.34	2230.0	2691.3	1.4186	5.8200	7.2386
115	169.02	0.001056	1.0359	1.0370	482.36	2041.1	2523.5	482.54	2216.3	2698.8	1.4735	5.7098	7.1833
120	198.48	0.001060	0.8911	0.8922	503.57	2025.5	2529.1	503.78	2202.4	2706.2	1.5278	5.6019	7.1297
125	232.01	0.001065	0.7698	0.7709	524.82	2009.7	2534.5	525.07	2188.3	2713.4	1.5815	5.4962	7.0777

11. A rigid vessel consist of 0.4 kg of hydrogen initially at 200 kPa and 27°C, heat is transferred to the system from a reservoir at 600K until its temperature reaches 450 K. Determine heat transfer, the change in entropy of hydrogen and the amount of entropy produced. (Take $c_v = 10.183\text{J/KgK}$) [8]
12. An engine working on a diesel cycle has a compression ratio of 16 and the cut off takes place at 8% of the stroke. Determine its air standard efficiency. What will be new efficiency if compression ratio is increased to 20? [Take $\gamma = 1.4$]. [8]
13. A 150 mm steam pipe ($k = 42\text{ W/mK}$) has inside diameter of 120 mm and outside diameter of 160 mm. It is insulated at the outside with asbestos ($k = 0.8\text{ W/mK}$). The steam temperature is 150°C and the air temperature is 20°C. The heat transfer co-efficient for inner and outer surfaces are 100 $\text{W/m}^2\text{K}$ and 30 $\text{W/m}^2\text{K}$. How thick should the asbestos to be provided in order to limit the hat loss to 2.1 kW/m^2 ? [6]

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P kPa	T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg.K
200	(120.24)	(0.8859)	(2529.4)	(2706.5)	(7.1272)
	150	0.9597	2576.7	2768.6	7.2793
	200	1.0803	2653.9	2870.0	7.5059
	250	1.1988	2730.8	2970.5	7.7078
	300	1.3162	2808.2	3071.4	7.8920
	350	1.4329	2886.7	3173.5	8.0624
	400	1.5497	2966.6	3276.4	8.2216
	450	1.6655	3047.9	3381.0	8.3714
	500	1.7814	3130.8	3487.1	8.5133
	550	1.8973	3215.4	3594.9	8.6483
	600	2.0130	3301.7	3704.3	8.7773
	650	2.1287	3389.7	3815.4	8.9011
	700	2.2443	3479.4	3928.3	9.0201
	750	2.3599	3570.9	4042.9	9.1350
	800	2.4755	3664.1	4159.2	9.2460
	850	2.5910	3759.1	4277.3	9.3536

P kPa	T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg.K
300	(133.56)	(0.6059)	(2543.5)	(2725.3)	(6.9921)
	150	0.6339	2570.7	2760.9	7.0779
	200	0.7163	2650.2	2865.1	7.3108
	250	0.7963	2728.2	2967.1	7.5157
	300	0.8753	2806.3	3068.9	7.7015
	350	0.9536	2885.9	3171.3	7.8729
	400	1.0315	2965.4	3274.9	8.0227
	450	1.1092	3047.6	3379.7	8.1630
	500	1.1867	3130.1	3486.1	8.2952
	550	1.2641	3214.7	3594.0	8.4204
	600	1.3414	3301.1	3703.5	8.5395
	650	1.4186	3389.1	3814.7	8.7134
	700	1.4958	3478.9	3927.7	8.8325
	750	1.5729	3570.5	4042.3	8.9475
	800	1.6500	3663.8	4158.8	9.0585
	850	1.7271	3758.8	4276.9	9.1661

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Thermodynamic Properties and Heat Transfer

11. a) Name the following complexes by IUPAC system [2+3]
- $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2$
 - $[\text{Co}(\text{en})_3]\text{Br}_3$
 - $\text{K}_2[\text{NiCl}_4]$
 - $[\text{Cr}(\text{C}_6\text{H}_6)_2]$
- b) How does Werner's theory explain the structures of complex compounds?
12. What are primary and low explosives? Give the preparation and uses of glycerol trinitrate. [2+3]
13. a) What is paint? Give the requisites of a good paint. [3+2]
- b) What are lubricating oils? Indicate their importance in engineering fields.
14. a) What isomerism is shown by butenedioic acid and why? [3+2]
- b) Differentiate between racemic mixture and meso compound.
15. What are elimination reactions? Write the mechanism of E^2 reaction taking an example. Show your acquaintance to Saytzeff's rule. [1+2+2]
16. What do you mean by S_N reactions? Explain reaction mechanism for the hydrolysis of 3° alkyl halide by aqueous sodium hydroxide. [1+4]

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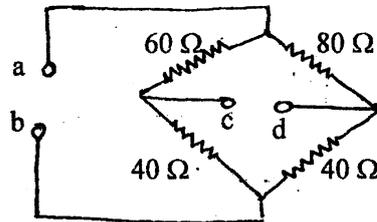
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Exam.	Regular		
	Level	BE	Full Marks
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

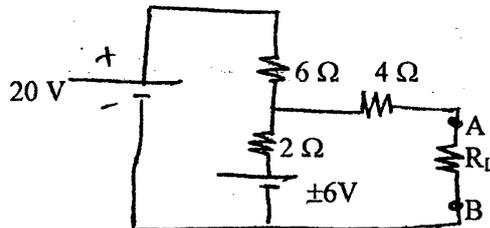
Subject: - Basic Electrical Engineering (EE451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

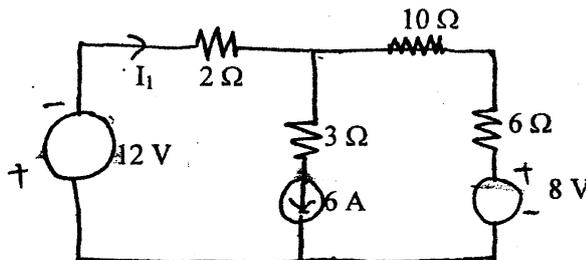
1. a) Explain resistance on the basis of Ohm's law and discuss different laws of resistance to define resistivity. Also explain how does the resistance of a conductor depend upon temperature. [6]
- b) In the resistive network shown in the figure below, find the: [4]
- (i) equivalent resistance between terminals 'a' and 'b' when
- (a) terminals 'c' and 'd' are open
 - (b) terminals 'c' and 'd' are shorted.
- (ii) equivalent resistance between terminals 'c' and 'd' when
- (a) terminals 'a' and 'b' are open
 - (b) terminal 'a' and 'b' are shorted.



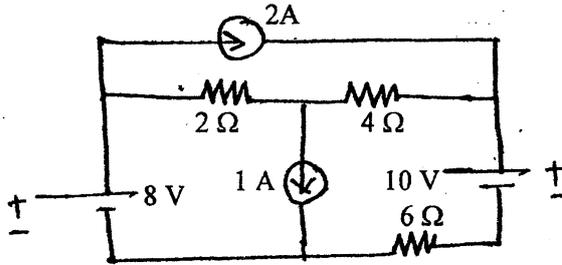
- c) What is internal resistance of source? Explain the significance of internal resistance of various sources with suitable examples. [6]
2. a) Find the Venin's equivalent circuit across AB for the following figure below and find the value R_L to obtain maximum power in R_L . Also determine the maximum power. [8]



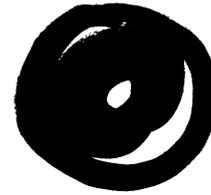
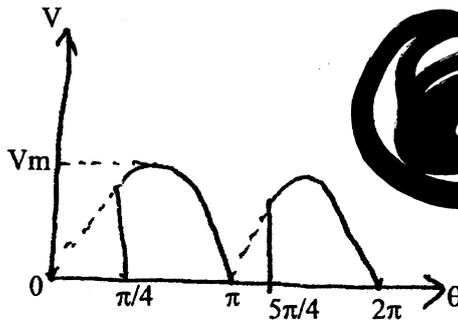
- b) Determine the current I_1 in the circuit shown below using superposition theorem. [8]



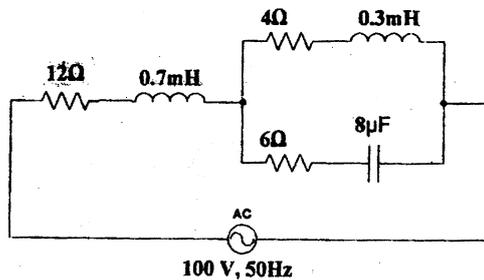
3. a) Obtain the current flowing through the 2 ohm resistor of the network shown below using mesh analysis. [8]



- b) State and explain the maximum power transfer theorem for dc networks and derive the expression for maximum power delivered by source. [8]
4. a) Calculate the average and rms value of voltage of full rectified sine wave shown in figure below. [6]



- b) A coil has an inductance of 0.05 H and a resistance of 10Ω. It is connected to a sinusoidal 200 V, 50 Hz supply. Calculate the impedance, current, power factor and power consumed. [6]
- c) What do you mean by power factor of an ac circuit? What are the causes and effects of low power factor? Why should it be corrected, describe the method of its correction. [4]
5. a) Determine the total impedance, power factor and current in each branch of the circuit below; Also draw the phasor diagram showing all the currents and voltages. [8]



- b) A three-phase load consists of three similar inductive coils each of resistance 8Ω and inductance 20 mH. The supply voltage is 100 V, 50 Hz. Calculate the line current and total power consumed by the load in star connection. Take phase sequence RYB. [8]